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Funds, 1989
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National Science Foundation

Detailed Statistical Tables

NSF 92-307

Research and Development in Industry: 1989

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Principal Author: John R. Gawalt

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Contributors

Data collection, preparation, and tabulation were performed by the Bureau of the Census, Department of Commerce, for the National Science Foundation. The principal author of this report was John R. Gawalt.

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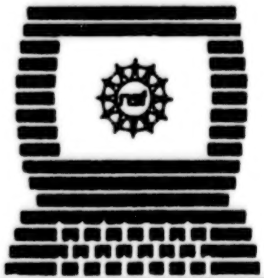

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GENERAL NOTES

The Bureau of the Census (Census), Department of Commerce, has conducted the annual Survey of Industrial Research and Development for the National Science Foundation (NSF) since 1957. This report provides data on research and development (R&D) funding for the years 1979-89 and on R&D personnel for the period from January 1979 to January 1990.

All companies--foreign and domestic as well as those privately held--that perform R&D in the United States are included or represented in the survey data.

The industry R&D survey does not cover trade associations. Although their primary mission is to serve industry, these associations are established as nonprofit organizations, and it is estimated that their R&D expenditures are less than 1 percent of the industry R&D total.

It is an enterprise- rather than an establishment-based survey. Therefore all R&D data for each enterprise are reported in the major Standard Industrial Classification (SIC) code of the firm. Data are aggregated in this manner for all tables in this report.

Data are based on probability samples selected about every five years. In intervening years, a subset of the last sample, called a "panel," is used. The latest probability sample was selected and first used for survey year 1987.

Census staff conduct the survey under Title 13 of the U.S. Code, which prohibits publication or release of data that may reveal information about individual companies. Therefore, on some tables of this report, the symbol "(D)" is used as a footnote reference to indicate that data are being withheld to avoid possible disclosure of information about operations of individual companies.

Complete technical notes are contained in section A of this report. Questions regarding the survey may be telephoned to John Gawalt, at (202) 634-4673, or mailed to him at the following address: National Science Foundation, Division of Science Resources Studies (L609), Washington, D. C. 20550.

SECTION A. TECHNICAL NOTES

Introduction

The Survey of Research and Development in Industry provides national estimates of the total expenditures on R&D performed within the United States by industrial firms, whether U.S.- or foreign-owned. It is a sample survey in which it is intended that all R&D-performing companies, including privately-held firms, are included or represented. All companies that are identified in the sample year as annually spending more than $1 million on R&D in the United States receive a survey form every year. Information from individual companies in the sample is used to develop national estimates on an industry-by-industry basis.

NSF has been sponsoring a survey of industrial R&D since 1953. The 1989 Survey of Research and Development in Industry is the 33rd in the annual series sponsored by NSF and conducted since 1957 by Census. NSF's Division of Science Resources Studies monitors the survey. NSF also sponsored two industrial R&D surveys covering the 1953-56 period that were conducted by the Bureau of Labor Statistics (BLS), Department of Labor.[1] Data obtained in the earlier BLS surveys are not directly comparable with Census figures for 1957-88 because of methodological and other differences in the surveys.

Respondents receive detailed definitions to help them determine which expenses to include or exclude from the R&D data they provide. Nevertheless, the statistics presented in this report are subject to response and concept errors caused by different respondent interpretations of the definitions of R&D activities and by variations in company accounting procedures. Consequently, the data are better indicators of changes in, rather than absolute levels of, R&D spending and personnel. Data quality has improved substantially since the first industry R&D survey was undertaken, mainly because respondents have adopted more accurate and sophisticated accounting procedures over the years.

The survey's primary focus is on U.S. industry as a performer of, rather than as a source of funds for, R&D. Thus, data on Federal support of R&D activities performed by industry are collected and appear in several tables, but data on industrial funding of R&D undertaken at universities and colleges and other nonprofit organizations are not included in the major tables.[2]

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[1] National Science Foundation, Science and Engineering in American Industry. Final Report on a 1953-54 Survey (NSF 56-16) and Science and Engineering in American Industry, 1956 (NSF 59-50) (Washington, D.C.: Supt. of Documents, U.S. Government Printing Office, 1956 and 1960)

The survey data provide (1) national estimates of total R&D performed by industry in the United States; (2) the portion of the effort that is financed by U.S. Government funds; and (3) the amount financed by the companies themselves or by other non-Federal sources such as state and local governments or other industrial firms (chart 1.) Also included are data on both the number of employees and the number of R&D-performing scientists and engineers at the firm, as well as on the domestic net sales for the company, and on the total funds for R&D financed by the domestic firm but performed outside the United States. A complete list of tables developed from the survey data is presented in section B, and copies of the 1989 survey form and other survey instruments are printed in section D.

The scope of the survey has been expanded and refined over the years in response to an increasing policy need for more detailed information on the Nation's R&D effort. For example, questions on energy R&D were added in the early seventies following the first oil-shortage crisis. On the other hand, the frequency of collection of certain data items has been reduced in an attempt to alleviate some of the respondent burden that has been placed on industry from all sources in recent years. The detailed questionnaire is now mailed only in odd-numbered years; abbreviated survey forms containing only the most crucial data elements are sent to respondents in the intervening, even-numbered years. The shortened survey form was used for the first time to collect industrial R&D data for 1978. Both long and short survey forms are called RD-1. This report provides data collected from the long form that covers 1989 data.

Questions appearing only biennially on the long form request detail on such areas as the following: R&D by product field, company expenditures for R&D projects that were contracted to outside organizations rather than performed in-house, Federal R&D support to the firm by contracting agency, R&D expenditures by geographic area, and some detailed data on energy and pollution-abatement R&D activities.

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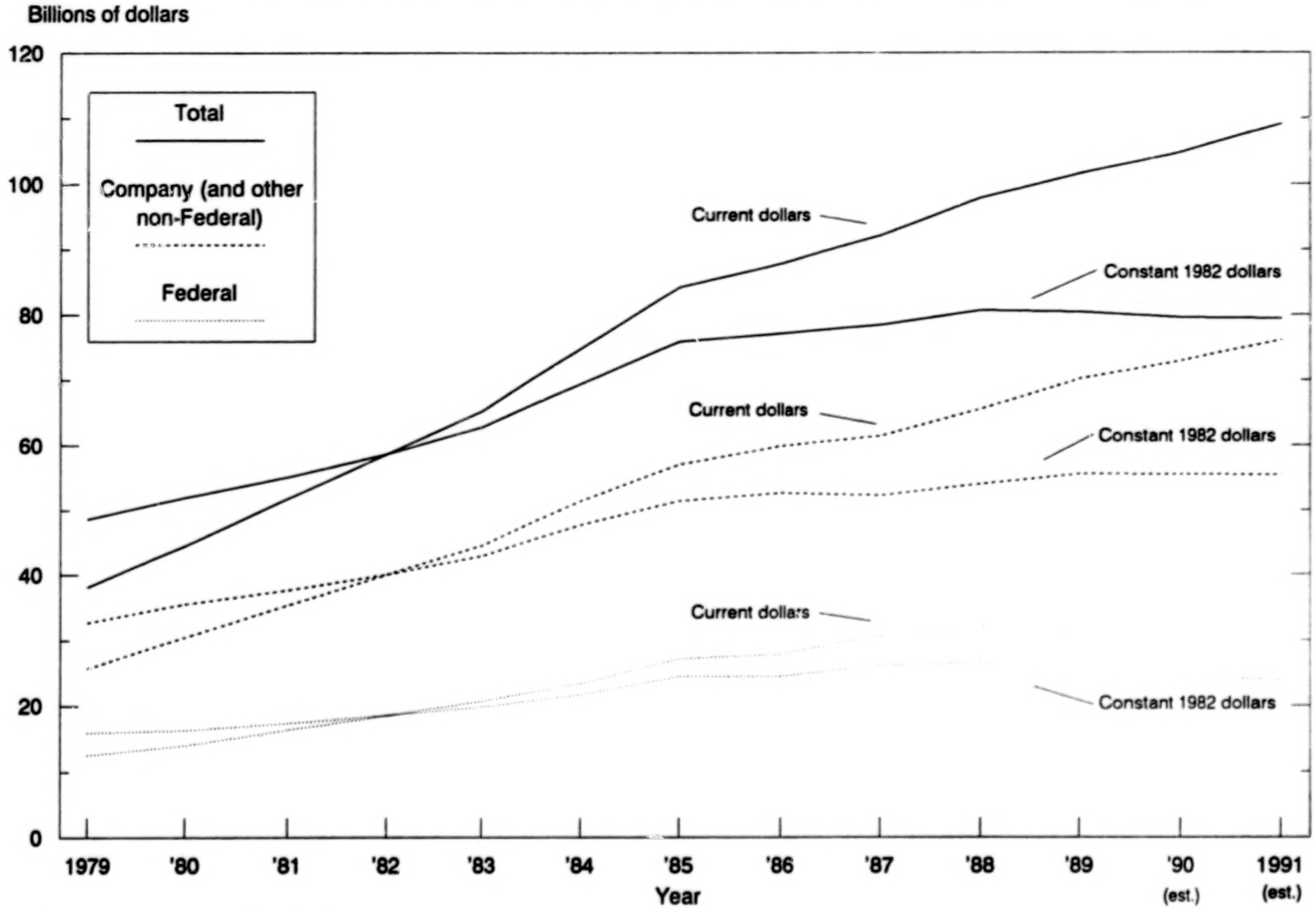
[2] Data on industry funding of R&D performed at universities and colleges are collected in the annual Survey of Scientific and Engineering Expenditures at Universities and Colleges. More information about this survey is available from the Science and Engineering Activities Program of NSF's Division of Science Resources Studies, (202) 634-4673.

Chart 1. Industrial R&D performance by source of funds



SOURCE: National Science Foundation, SRS

Methodology of Survey[3]

Overview

Data in this survey are based on a sample of industrial firms, selected approximately every five years (e.g., 1976, 1981, 1987). In intervening years only a subset of the sample, or "panel," receives annual survey forms (for a complete discussion, see **The Annual Panel**) and Census makes estimates for the changes in R&D for the firms not canvassed annually. The sampling unit for this survey is the enterprise, or company, defined as a business organization consisting of one or more establishments under common ownership or control. The 1989 data in this publication are based on responses from a panel derived from the sample selected and first used for survey year 1987. (The previous sample was selected for the 1981 survey and the panel was used in subsequent annual surveys until 1987.)

The sampling frame from which the sample was drawn includes companies in all manufacturing industries and, on the basis of earlier samples, a select number of nonmanufacturing industries known to conduct R&D.

The Standard Statistical Establishment List (SSEL), a Census compilation that contains information on 3.5 million to 4.0 million establishments, was the universe frame used to select the 1987 sampling frame. Where necessary for multi-establishment companies, Census summed establishment-level data to the company level, and then assigned a single Standard Industrial Classification (SIC) code to that firm--the SIC code of the establishment(s) having the highest dollar-value of payroll.[4]

The weight given to an individual company is in general the inverse of the probability that the company would have been selected for inclusion in the sample. Certainty companies (for a detailed discussion, see **Frame Creation**) have a weight of 1.00. The company weight is retained in both the sampling year and in the years between samples. To minimize respondent burden, only the "panel" subset of the sample is canvassed between sample years. Most small firms are not re-contacted, but in each succeeding year Census estimates the data for each non-canvassed firm, based on the changes in the initial value of the R&D reported by the firm, and the average growth rate for the firm's industry.

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[3] The information presented in this section was provided by the Industry Division of the Bureau of the Census, the collecting and compiling agent for the National Science Foundation.

[4] Executive Office of the President, Office of Management and Budget, Standard Industrial Classification Manual, 1972 (Washington, D.C.: Supt. of Documents, U.S. Government Printing Office).

Frame Creation

In selecting a sample frame from which to draw a sample of R&D-performing industries, NSF staff make certain assumptions about industries to be able to maximize sampling efficiency given a finite budget for sample selection. That is, they apply *a priori* knowledge of industrial R&D activity to eliminate some industries from the possibility of selection by the initial SSEL sort and to designate other companies for sampling with 100 percent certainty. In addition, NSF staff made several innovations for the sample drawn in 1987 to improve its quality.

As in previous sample years, all companies that had been on the previous panel once again received a survey form. In addition, Census staff reviewed lists of R&D contractors published by the Department of Defense (DOD) and the National Aeronautics and Space Administration (NASA) to ensure that all their large industrial R&D-performing contractors were included in the sample with certainty.

From the outset in the latest sample selection, the major goal was to eliminate from the sampling frame, to the greatest extent possible, companies unlikely to have R&D programs. This was done to minimize the number of companies chosen for the sample which had no R&D activity. To accomplish this objective, two steps were taken:

1. NSF staff narrowed the list of nonmanufacturing industries considered in-scope, by eliminating those likely to engage in little or no R&D activity. Thus, companies in the eliminated nonmanufacturing industries had no chance of being selected. This gave companies in the manufacturing industries and the remaining nonmanufacturing industries a greater probability of selection than they had in past sample selections.

2. Companies below a certain employment size level--even in some in-scope industries--were eliminated from the universe frame. An assumption was made that companies with only a small number of employees in some industries are unlikely to engage in R&D activity. NSF staff provided an employment cutoff for each industry group. Generally the cutoff in the selected industries was 250 employees, but hospitals were given an employment cutoff of 1,000 employees. Those companies with smaller employment levels were eliminated from the frame.

Further, all companies with more than 500 employees in the in-scope industries, except for hospitals that had a cutoff of 1,000 employees, were sampled with certainty.

In another effort to improve coverage of R&D-performing

companies, NSF staff in 1987 provided to Census the names of firms, identified through media reports or other sources as R&D performers, that were to be included in the sample with certainty. Most of these companies would have received questionnaires anyway because they met other established criteria; the few that did not were added to the sample by Census.

All certainty companies--those on lists provided by NSF staff, on lists of DOD and NASA contractors, companies with more than 500 employees, and previous panel members--are self-representing, i.e., they have sampling weights of unity (1.00).

Based on (1) SIC code, (2) total employment cutoffs, (3) inclusion on an NSF, DOD, or NASA list, or (4) previous panel membership, approximately 154,000 companies were identified as in-scope of the survey and therefore were included in the sampling frame. The new efforts to improve targeted coverage resulted in a sharp reduction in the size of the total in-scope universe; it dropped from about 450,000 companies in the 1981 sampling frame to approximately 154,000 companies in the latest operation.

It is likely that a small number of companies actually engaged in R&D activity was omitted from the sampling frame as a result of these first-time sample selection operations. It was agreed, however, that the benefit from the new operations--greater sampling efficiency resulting in improved national estimates of industrial R&D expenditures and employment--far outweighed the cost of the loss of a few companies that may have been eliminated from the in-scope sampling frame.

Probability Proportionate to Size

As with most types of economic surveys, the sample selection process for the industrial R&D survey used probabilities proportionate to size. That is, "large" companies have a proportionately higher probability of selection than do "small" companies, where large or small is measured relative to the statistic being estimated.

For the R&D survey, it would have been ideal if size could be determined by the amount of a company's R&D expenditures. Unfortunately, except for the companies that were in the current panel, it was impossible for Census to know the R&D expenditure values for firms in the universe frame. One logical solution was to estimate each company's R&D expenditures and base the probability of selection on the estimated values. This strategy had been employed in the 1981 sampling operation.

Clearly, this strategy has weaknesses. Even with the reduced number of in-scope industries in the sampling frame, many companies chosen for the frame may not have engaged in any R&D activity. Nevertheless, the procedure used to estimate the size of companies, described in the following paragraph, was forced to treat all companies as if they did in fact, perform R&D:

Census estimated the size of each company's R&D expenditures by using a relationship linking the size of its employment to its amount of R&D expenditures. [Since company employment was known for the universe, it was possible to use this relationship to estimate R&D expenditures values for all companies in the frame. Census derived this relationship for each SIC classification category, using data collected in the then most recent (1985) R&D survey]. Rather than treating all companies equally, the larger the number of employees in a company, the higher the probability of selection for inclusion in the sample. It was deemed reasonable to assume that large companies were more likely to have R&D programs than small companies.

One further adjustment was introduced that had not been made in previous sample selections. This was based on the assumption that multi-establishment companies of a given size and in a given industry would on average be expected to perform more R&D than single-establishment companies of the same size and in the same industry. Once again, 1985 panel data were used to develop this adjustment factor. Finally, it should be noted that the actual reported R&D activity, not an imputed value, was used for companies which were in the previous panel, and the data were not adjusted.

Sample Allocation and Relative Standard Error Constraints

The sampling program utilized for this operation allowed parameters to be assigned permitting the sample to be allocated across various levels, or strata, that correspond to industry groupings. This procedure permitted a desired sample size or a desired sampling error to be achieved for each stratum. Estimated errors of total R&D estimates for these strata were not to exceed certain levels. Since the amount of funds provided by NSF determined the size of the sample to be drawn, the only constraint in achieving these results was that the total sample size across all the strata could not exceed 12,000-13,000 companies. NSF staff provided relative rankings for each industry group--high, medium, or low--to determine the precision of the estimate. An actual translation to what high, medium, or low meant specifically could not be determined until Census staff arbitrarily investigated several sampling error levels, computed the sample size that these levels implied, and applied the constraint of the total sample size of 13,000. The result of this investigation led to the following criteria for the target sampling error of estimate of funds for R&D performance:

a. High precision: sampling error not to exceed 2 percent

b. Medium precision: sampling error not to exceed 5 percent

c. Low precision: sampling error not to exceed 10 percent

Based on the desired precision, these criteria suggested a total sample size of approximately 13,500. This number was not excessively beyond the stated limit of 13,000, so this was the sample size parameter chosen for the selection process.

One limitation should be noted. Sampling errors were controlled by using a universe total that in large part was improvised; that is, and as previously noted, Census assigned an R&D value to every company in the frame, even though many companies in the sampling frame may not actually have had R&D expenditures. The value assigned was imputed for the great majority of companies in the frame, and, as a consequence, the estimated universe and the distribution of individual company values did not necessarily reflect reality. Estimates of sampling variability were nevertheless based on this distribution. The presumption was--and this had been confirmed in the previous sample selection--that actual variation in the sample design would be less than that estimated because many of the sampled companies have true R&D values of zero, not the widely varying values that were imputed using total employment as a predictor of R&D. Thus, the 2 percent, 5 percent, and 10 percent error levels described earlier are conservative. [See table A-1 for a complete list of the actual standard errors in the 1989 survey.]

The particular sample selected is one of a large number of the same type and size that, by chance, might have been selected. Estimates from each of the different samples would differ somewhat from each other and from the results of a complete canvass conducted under essentially the same conditions as the survey.

In addition to sampling error, the estimates are subject to nonsampling error that would also occur if a complete canvass were to be conducted under the same conditions.

Sample Selection

The sample selection program was run with a specified sample size (expected) of 13,500 and with other parameters set to ensure compliance with the relative standard error constraints. An actual sample of 13,917 was selected. The actual sample size differs from the specified for two reasons:

First, the program used independent sampling. Each company had an independent chance of selection based on its assigned probability; the selection, or nonselection, of a company was completely independent of the selection of any other company.

Table A-1. Standard error of estimate (percentage) of funds for R&D performance for all company size-groups and for companies with fewer than 1,000 employees, by industry: 1989

Industry	SIC code	Standard error(1)	Standard error of companies with fewer than 1,000 employees
Total	....	0.7	7.0
Food, kindred, and tobacco products	20,21	0.0	0.0
Textiles and apparel	22,23	9.0	50.5
Lumber, wood products, and furniture	24,25	0.6	7.8
Paper and allied products	26	4.3	29.9
Chemicals and allied products	28	2.7	39.0
Industrial chemicals	281-82,286	0.6	26.5
Drugs and medicines	283	0.7	31.1
Other chemicals	284-85,287-89	13.3	52.1
Petroleum refining and extraction	13,29	0.2	24.0
Rubber products	30	1.9	22.7
Stone, clay, and glass products	32	0.8	32.5
Primary metals	33	1.1	25.8
Ferrous metals and products	331-32,3398-99	3.1	52.8
Nonferrous metals and products	333-36	0.4	10.7
Fabricated metal products	34	5.2	22.7
Machinery	35	2.4	22.7
Office, computing, and accounting machines	357	2.9	42.4
Other machinery, except electrical	351-56,358-59	3.9	14.1
Electrical equipment	36	1.9	17.0
Radio and TV receiving equipment	365	8.4	26.0
Communication equipment	366	2.6	47.0
Electronic components	367	4.4	21.2
Other electrical equipment	361-64,369	1.5	11.5
Transportation equipment	37	0.1	33.8
Motor vehicles and motor vehicles equipment	371	0.4	71.1
Other transportation equipment	373-75,379	1.4	26.0
Aircraft and missiles	372,376	0.0	0.0
Professional and scientific instruments	38	1.1	8.6
Scientific and mechanical measuring instruments	381-82	2.3	10.1
Optical, surgical, photographic, and other instruments	383-87	1.2	15.1
Other manufacturing industries	27,31,39	1.8	12.8
Nonmanufacturing industries	10-11,14-17,40-42,44-51,53-54,56,60,62-63,72-73,78,806-07,87	3.7	8.1

(1) A description of the standard error of estimate is given in section A under "Methodology of Survey." The percentage (or relative) standard errors in this table may be converted to standard errors of estimate by multiplying the percentages shown by the associated estimates. For example, the relative standard error of estimate for R&D performance for all company size groups in the chemicals industry (SIC 28) is shown as 2.7 percent, and the associated total R&D estimate for this industry is shown as $11,537 million in table B-3, "Total (company and Federal) funds for industrial R&D performance by industry and size of company: 1979-89." The standard error of estimate, then, is .027 times 11,537 or 312.5.

SOURCE: National Science Foundation, SRS

In independent sampling, sample size is itself a random variable. Theoretically, a sample of size zero or a sample the size of the entire universe is possible, but the probabilities of these extremes are so small that these are nearly impossible situations. The actual sample size is usually quite close to the specified size. If there is too much deviation, the program is simply executed again.

Second, a minimum probability rule was imposed. As noted earlier, the sampling program assigns probabilities proportionate to size (where size in this case is the imputed R&D value assigned each company). Selected companies that have R&D programs vastly larger than their assigned values can have adverse effects on the estimates once the data are collected. To lessen these effects, the maximum weight a company can assume was arbitrarily controlled by specifying that the probability of selection cannot be less than a certain value. If the probability based on its size is less than this minimum value, then it is set equal to this value. The consequence of raising these original probabilities to the minimum probability is to raise the expected sample size. It is likely that most of the difference between the specified sample size and the actual sample size is due to this rule.

The Annual Panel

The panel is a group of companies that receive a survey questionnaire, form RD-1, annually. The following is a description of how the present panel was formed from the new sample in 1987:

The basic tool for the survey is form RD-1, which is used to collect detailed R&D information. Companies that were in the old panel and had received a 1986 RD-1 form (1,095 companies) once again received an RD-1 form for 1987. The remaining certainty companies (6,903) and noncertainty companies (5,919) in the new sample received an RD-1A survey form for 1987. Form RD-1A is an abbreviated version of RD-1 and is generally mailed to companies only in the year in which a new sample is drawn. The purpose is to canvass smaller R&D performers, while imposing a minimum of reporting burden on them.

Of the 13,917 companies that received a form in 1987, 3,648 respondents reported that their companies were R&D performers, or were identified as R&D performers based on information from other sources. The 3,648 companies were ranked by total R&D funds (both Federal and company and other) within each SIC code. All companies with over $1 million in total R&D expenditures were placed on the RD-1 panel. In addition, in some industries Census added to the panel companies with less than $1 million in R&D expenditures, in an attempt to ensure 95 percent coverage of the R&D total for each industry.

The result of this process was an increase of panel size from 1,095 companies based on the previous sample to 1,742 companies based on the sample drawn in 1987. All companies selected for the panel will receive the RD-1 questionnaire annually until the next sample is drawn. The other companies will not receive another questionnaire; their R&D data will be estimated in subsequent years by Census staff, using their 1987 reports as a base.

Imputation for Item Non-Response

The 1989 survey questionnaires were mailed in January 1990, and recipients were asked to respond within 60 days. After 60 days, an initial set of follow-up letters was sent to all nonresponding firms. Two additional follow-up mailings were made to persistent nonrespondents at 90 and 120 days. In addition to the follow-up mailings, telephone follow-up was used to encourage response among those nonresponding firms ranked among the 200 largest R&D performers, based on 1988 expenditures.

Even when forms are returned, however, they are often incomplete. Many firms choose to return the survey forms with one or more items blank, for varying reasons--for instance, the internal accounting procedures of the firm may not allow it to quantify R&D by, say, pollution-abatement expenditures. In addition, some firms as a matter of policy refuse to answer any voluntary questions. Four data items on the RD-1 questionnaire (total R&D expenditures, Federal R&D funds, net sales, and total employment), however, are in fact included in Census' mandatory statistical program. Therefore the companies that had not returned form RD-1 for 1989 were mailed MA-121 forms, which are abbreviated questionnaires used to collect only the items for which replies are mandatory. The response rate for these mandatory items was significantly higher than for the other items on the survey.

When respondents do not provide the requested information, Census estimates the missing data for each firm using an imputation algorithm. In general, the imputation algorithms employed by Census compute values for missing items by applying the average percentage change for the target item in the nonresponding firm's industry to the item's prior year value for that firm, reported or imputed. This approach, with minor variation, is used for most items on the survey form. Note that all items for non-panel firms--that is, firms that are surveyed in the sample year but which because of size are not surveyed again until a new sample is selected, are estimated in the non-sample years using these imputation processes.

Table A-2 contains imputation rates for the principal survey items. For a detailed discussion of the problems stemming from item nonresponse, see the Technical Report, Estimating Basic and Applied Research and Development in Industry: A Preliminary Review

Table A-2. Imputation rates for selected items on the research and development survey, by industry: 1989

[Percent]

Industry	SIC code	Net sales	Total Employment	R&D scientists/ engineers	Total R&D			Federal R&D by agency
					Total	Company	Federal	
Total		18.8	27.8	36.2	7.8	10.8	13.6	57.8
Food, kindred, and tobacco products	20,21	14.1	15.9	45.1	3.2	5.9	0.0	0.0
Textiles and apparel	22,23	57.0	62.0	51.6	38.1	58.6	0.0	0.0
Lumber, wood products, and furniture	24,25	21.9	38.9	68.7	7.1	13.3	-	-
Paper and allied products	26	15.7	18.8	48.3	11.2	32.5	-	-
Chemicals and allied products	28	8.4	13.2	38.8	4.1	10.5	2.0	54.1
Industrial chemicals	281-82,286	3.4	3.1	57.4	1.7	2.0	0.9	52.7
Drugs and medicines	283	4.8	6.9	40.5	1.4	14.1	27.6	85.8
Other chemicals	284-85,287-89	18.3	32.4	14.3	14.8	17.5	0.0	0.0
Petroleum refining and extraction	13,29	4.8	6.2	29.1	0.3	24.6	68.6	76.3
Rubber products	30	23.9	47.9	67.2	8.5	8.6	0.0	0.0
Stone, clay, and glass products	32	25.7	26.3	15.5	2.8	3.7	0.0	2.1
Primary metals	33	24.5	32.3	49.4	7.4	15.8	5.7	43.6
Ferrous metals and products	331-32,3398-99	31.3	43.3	58.6	14.0	36.4	90.3	90.3
Nonferrous metals and products	333-36	16.2	18.5	44.4	3.7	3.8	2.4	41.8
Fabricated metal products	34	44.2	53.2	40.3	16.1	27.4	0.0	46.7
Machinery	35	13.3	20.1	18.5	4.2	8.8	68.4	68.1
Office, computing, and accounting machines	357	2.1	3.9	14.2	0.7	4.8	74.6	70.6
Other machinery, except electrical	351-56,358-59	24.7	33.2	39.4	18.9	24.5	2.8	34.4
Electrical equipment	36	14.8	16.1	43.8	5.0	9.3	4.3	45.9
Radio and TV receiving equipment	365	39.9	40.0	17.7	32.1	32.1	-	-
Communication equipment	366	7.9	5.9	36.8	2.9	4.1	5.5	45.0
Electronic components	367	14.2	20.4	51.2	5.5	11.3	5.7	43.8
Other electrical equipment	361-64,369	24.3	26.8	54.4	10.7	22.0	0.1	49.6
Transportation equipment	37	5.1	4.8	32.6	9.3	1.6	12.6	62.2
Motor vehicles and motor vehicles equipment	371	6.6	7.3	39.6	0.7	1.9	0.3	37.5
Other transportation equipment	373-75,379	27.2	25.8	86.4	4.7	8.0	0.0	29.8
Aircraft and missiles	372,376	1.0	1.2	28.1	13.1	0.8	14.0	65.1

See footnotes at end of

Table A-2. Imputation rates for selected items on the research and development survey, by industry: 1989 (continued)

[Percent]

Industry	SIC code	Net sales	Total Employment	R&D scientists/ engineers	Total R&D: Total	Total R&D: Company	Total R&D: Federal	Federal R&D by agency
Professional and scientific instruments..	38	13.0	17.9	68.0	6.5	13.7	20.5	95.8
Scientific and mechanical measuring instruments............................	381-82	18.8	34.0	75.4	10.3	17.1	52.0	0.0
Optical, surgical, photographic, and other instruments......................	383-87	10.7	12.0	61.5	4.6	12.1	17.6	95.4
Other manufacturing industries...........	21,27,31,39	26.5	31.8	49.9	8.0	12.3	0.0	0.0
Nonmanufacturing industries..............	10-11,14-17,40-42,44-51,53-54,56,60,62-63,72-73,78,806-07,87	37.6	50.6	33.4	20.5	31.5	14.6	41.1

[Percent]

Industry	SIC code	R&D by cost: Wages	R&D by cost: Materials	Other costs	Fields of basic research	R&D by state	Energy R&D	Pollution abatement	R&D outside company	Foreign R&D
Total..		51.2	49.7	48.1	44.7	31.2	27.9	53.6	13.1	3.8
Food, kindred, and tobacco products......	20,21	52.1	55.0	51.9	4.8	50.4	0.0	0.0	9.1	14.1
Textiles and apparel......................	22,23	72.9	60.7	75.2	96.5	68.7	0.0	0.0	2.3	-
Lumber, wood products, and furniture.....	24,25	57.1	74.8	58.0	96.9	61.5	51.7	0.0	90.9	0.0
Paper and allied products................	26	61.9	57.7	64.1	8.9	58.8	1.9	11.0	1.0	0.0
Chemicals and allied products............	28	48.5	52.2	50.0	46.9	51.8	37.4	38.6	6.4	6.4
Industrial chemicals....................	281-82,286	53.1	53.2	53.1	23.8	80.4	38.0	48.8	6.3	5.5
Drugs and medicines.....................	283	57.7	57.4	57.5	68.0	41.3	0.0	2.3	8.6	11.5
Other chemicals.........................	284-85,287-89	23.6	28.5	25.5	30.7	24.9	1.0	0.0	0.6	0.9
Petroleum refining and extraction........	13,29	38.1	38.3	38.2	22.6	14.3	25.9	0.0	0.0	6.3
Rubber products..........................	30	41.7	42.1	42.4	11.9	22.0	0.4	0.0	0.9	0.9
Stone, clay, and glass products..........	32	20.4	19.3	20.1	14.4	16.2	0.0	0.0	0.0	0.0
Primary metals...........................	33	54.3	52.7	66.0	78.6	36.5	0.0	8.8	11.4	6.0
Ferrous metals and products............	331-32,3398-99	53.9	55.2	53.1	0.0	56.6	0.0	0.0	0.0	0.0
Nonferrous metals and products.........	333-36	54.5	51.4	72.8	82.1	25.6	0.0	10.8	13.2	6.0
Fabricated metal products................	34	61.3	63.8	60.3	7.6	53.0	6.0	0.0	29.3	0.0

See footnotes at end of

Table A-2. Imputation rates for selected items on the research and development survey, by industry: 1989 (continued)

[Percent]

Industry	SIC code	R&D by cost			Fields of basic research	R&D by state	Energy R&D	Pollution abatement	R&D outside company	Foreign R&D
		Wages	Materials	Other costs						
Machinery	35	29.2	26.7	25.5	77.6	11.0	0.8	9.8	1.6	0.5
Office, computing, and accounting machines	357	25.0	21.3	21.5	90.5	4.0	0.0	-	0.9	0.1
Other machinery, except electrical	351-56,358-59	43.6	43.4	51.9	35.2	40.2	0.8	9.8	6.6	5.1
Electrical equipment	36	56.4	58.1	50.3	19.5	17.8	21.1	1.1	15.9	5.8
Radio and TV receiving equipment	365	95.7	97.2	96.3	89.1	35.9	-	-	-	0.0
Communication equipment	366	47.4	55.2	42.0	6.9	14.5	0.1	16.6	17.9	1.7
Electronic components	367	68.3	69.3	68.5	9.6	12.8	90.5	0.0	3.2	1.8
Other electrical equipment	361-64,369	54.7	51.4	57.3	63.4	62.5	3.9	0.1	25.8	30.7
Transportation equipment	37	54.5	49.2	50.9	17.7	35.7	34.8	73.3	3.2	0.4
Motor vehicles and motor vehicles equipment	371	41.4	40.3	38.7	53.7	8.6	95.4	85.1	0.2	0.1
Other transportation equipment	373-75,379	77.8	76.7	74.4	75.4	31.3	0.0	0.0	93.2	0.0
Aircraft and missiles	372,376	59.8	53.7	55.2	12.0	47.2	13.9	9.0	2.2	1.2
Professional and scientific instruments	38	86.9	87.0	87.1	67.6	36.2	26.5	8.0	86.5	12.0
Scientific and mechanical measuring instruments	381-82	85.8	86.6	86.3	73.9	24.2	19.8	46.4	26.3	1.2
Optical, surgical, photographic, and other instruments	383-87	87.5	87.1	87.5	66.7	42.1	73.6	0.0	87.4	12.5
Other manufacturing industries	21,27,31,39	60.2	65.8	60.5	41.6	43.3	0.0	0.0	25.8	14.5
Nonmanufacturing industries	10-11,14-17,40-42,44-51,53-54,56,60,62-63,72-73,78,806-07,87	46.0	46.3	45.9	67.0	37.8	42.5	51.9	14.8	22.2

- Represents no basis for imputation.

SOURCE: National Science Foundation, SRS

of Survey Procedures, NSF 90-322.

There are two survey items which do not use this general imputation methodology, they are (1) geographic distribution of R&D expenditures, and (2) R&D expenditures distributed by basic research, applied research, and development (character-of-work).

The imputation method for computing estimates of the geographic distribution of R&D expenditures was revised in 1989 to include the use of secondary source information as well as focussed telephone follow-up. The secondary source used is the Directory of American Research and Technology 1990, R. R. Bowker, New York, which lists the locations of R&D laboratories for over 6,700 firms in the U.S. R&D expenditures for nonresponding firms listed in this directory as having laboratories in only a single state were assigned to that state. The remaining nonresponding firms were contacted by telephone and asked to distribute their reported R&D expenditures; most were able to provide this information. This modified approach is used only for nonresponding firms ranked among the two hundred largest R&D performers. The imputation rates listed in table A-2 reflect gains made using this method.

The imputation procedure used for the basic research, applied research, and development expenditure estimates was revised in 1987 for use with 1986 and later data, and also differs from the general imputation approach.

Response to character-of-work items has been declining in recent years and, as a result, their imputation rates have been increasing. The general imputation procedure became increasingly dependent upon information which had been imputed in prior years thereby distancing current year distribution estimates from the time at which they were reported. In addition, to reduce the reporting burden of this survey, smaller, non-panel firms in the sample have never been asked to disaggregate their R&D expenditures into character-of-work categories, consequently, imputation is required for all such firms.

Because of the increasing dependence on imputed data, NSF chose not to publish estimates of industrial basic research, applied research, and development in this report beginning in 1986.

In 1987, Census revised its approach for imputing character-of-work estimates. The revised method calculates the character-of-work distribution for a non-responding firm only if that firm reported a distribution within a five-year time period extending from two-years before to two years after the year requiring imputation. Imputation for a given year is initially performed in the year the data are collected and is based on a character-of-work distribution reported in either of the two previous years, if any. It is again performed using new data collected in the next two years. Thus, character-of-work estimates are revised as newly reported information becomes available and are not final for two years following their initial publication. This revised imputation procedure was first used for the 1986 estimates.

If reported data are not available for a firm, Census does not impute a character-of-work distribution for that firm. As a consequence of this restriction, only approximately 70 percent of the total estimated R&D expenditures was distributed across these categories in the 1986 Census estimates. Those expenditures not meeting the requirements of the new imputation methodology were placed in the newly created "Not distributed" category.

Tables A-3 through A-5 show the current character-of-work estimates provided by Census along with the not distributed component for 1987, 1988, and 1989.

NSF's objective in this survey is to provide estimates for the entire population of firms performing R&D in the U.S. As the revised Census imputation procedure no longer produces such estimates (because of the not distributed component) this objective is no longer being met for character-of-work estimates. NSF sought alternative methods.

A separate NSF Technical Report, Estimating Basic and Applied Research and Development in Industry: A Preliminary Review of Survey Procedures, NSF 90-322, presents character-of-work estimates for 1986, 1987, and 1988 and examines several alternative approaches to apportioning the "Not distributed" data to the basic research, applied research, and development categories. The tables in the report illustrate how estimated figures for basic research, applied research, and development can vary depending on assumptions made about the R&D expenditures which are not distributed by Census by character-of-work. Explanations of the assumptions underlying different estimates are provided, along with an overview of the Survey of Industrial Research and Development and an explanation of some general problems of missing information.

The 1987, 1988, and 1989 estimates of basic research, applied research, and development provided in section B of this report were calculated using the baseline estimation method presented in report NSF 90-322. In the baseline estimation method, the not distributed expenditure data are allocated, by industry group, to basic research, applied research, and development categories using the percentage splits in the distributed category for that industry. The allocation is done at the lowest level of published industry detail only; higher levels are derived by aggregation.

Table A-3. Funds distributed for basic research, applied research, and development, by industry and size of company, by source of funds: 1987

[Dollars in millions]

Industry and size of company	SIC code	Total: Total	Total: Federal	Total: Company	Distributed funds: Basic: Total	Basic: Federal	Basic: Company	Applied: Total	Applied: Federal	Applied: Company	Development: Total	Development: Federal	Development: Company
Total		$92,155	$30,752	$61,403	$2,866	$534	$2,332	$14,068	$3,510	$10,558	$49,589	$18,770	$30,819
Distribution by industry													
Food, kindred, and tobacco products	20,21	1,206	2	1,204	51	0	51	(D)	(D)	330	567	0	567
Textiles and apparel	22,23	(D)	(D)	243	(D)	0	(D)	6	0	6	(D)	(D)	107
Lumber, wood products, and furniture	24,25	137	0	137	15	0	15	25	0	(S)	50	0	50
Paper and allied products	26	(D)	(D)	604	25	0	25	124	0	124	(D)	(D)	187
Chemicals and allied products	28	9,635	190	9,445	479	14	465	2,550	102	2,448	3,601	66	3,535
Industrial chemicals	281-82,286	3,716	185	3,531	(D)	(D)	214	1,007	102	905	(D)	(D)	1,366
Drugs and medicines	283	(D)	(D)	4,095	235	0	235	1,023	0	1,023	(D)	(D)	1,414
Other chemicals	284-85,287-89	(D)	(D)	1,819	(D)	(D)	26	520	0	520	755	0	755
Petroleum refining and extraction	13,29	1,897	14	1,883	(D)	(D)	70	(D)	(D)	617	599	9	590
Rubber products	30	(D)	(D)	596	12	0	(S)	(D)	(D)	(D)	174	(D)	(D)
Stone, clay, and glass products	32	995	10	985	(D)	(D)	142	(D)	(D)	(S)	(D)	(D)	321
Primary metals	33	730	19	711	(D)	(D)	58	(D)	(D)	173	308	10	298
Ferrous metals and products	331-32,3398-99	(D)	(D)	249	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	59
Nonferrous metals and products	333-36	(D)	(D)	462	57	1	(D)	111	(D)	(D)	(D)	(D)	239
Fabricated metal products	34	783	150	633	25	0	(S)	(D)	(D)	64	(D)	(D)	233
Machinery	35	(D)	(D)	10,577	(D)	(D)	223	(D)	(D)	1,485	(D)	(D)	7,167
Office, computing, and accounting machines	357	(D)	(D)	8,193	(D)	(D)	136	(D)	(D)	1,171	(D)	(D)	5,920
Other machinery, except electrical	351-56,358-59	2,428	44	2,384	(S)	0	(S)	(D)	(D)	314	(D)	(D)	1,247
Electrical equipment	36	15,848	5,399	10,449	619	(D)	(D)	2,677	(D)	(D)	8,640	3,375	5,265
Radio and TV receiving equipment	365	139	0	139	(D)	0	(D)	(D)	0	(D)	5	0	(S)
Communication equipment	366	10,184	4,729	5,455	(D)	(D)	(D)	(D)	(D)	(D)	6,882	3,165	3,717
Electronic components	367	4,286	656	3,630	(D)	(D)	(S)	(D)	(D)	(S)	(D)	(D)	(D)
Other electrical equipment	361-64,369	1,239	14	1,225	69	0	(S)	(D)	(D)	115	(D)	(D)	(D)
Transportation equipment	37	34,246	20,784	13,462	396	(D)	(D)	2,998	(D)	(D)	22,161	13,472	8,689
Motor vehicles and motor vehicles equipment	371	(D)	(D)	7,167	(D)	(D)	65	(D)	(D)	(D)	(D)	(D)	4,520
Other transportation equipment	373-75,379	(D)	(D)	356	(D)	0	(D)	(D)	(D)	(D)	(D)	(D)	65
Aircraft and missiles	372,376	24,458	18,519	5,939	329	249	80	2,364	1,269	1,095	16,335	12,232	4,103

See footnotes at end of table

Table A-3. Funds distributed for basic research, applied research, and development, by industry and size of company, by source of funds: 1987 (continued)

[Dollars in millions]

Industry and size of company		Distributed funds											
		Total			Basic			Applied			Development		
Distribution by industry	SIC code	Total	Federal	Company	Total	Federal	Company	Total	Federal	Company	Total	Federal	Company
Professional and scientific instruments...........	38	$5,222	$272	$4,950	(D)	(D)	$259	(D)	(D)	(S)	(S)	(S)	(S)
Scientific and mechanical measuring instruments.	381-82	(D)	(D)	1,598	$38	$0	38	(D)	(D)	(S)	(D)	(D)	$261
Optical, surgical, photographic, and other instruments..................................	383-87	(D)	(D)	3,352	(D)	(D)	(S)	(D)	(D)	(S)	(D)	(D)	(S)
Other manufacturing industries....................	27,31,39	(D)	(D)	380	(S)	0	(S)	$25	$0	$25	$206	$0	206
Nonmanufacturing industries.......................	10-11,14-17,40-42,44-51,53-54,56,60,62-63,72-73,78,806-07,87	7,844	2,700	5,144	442	197	(S)	1,600	761	(S)	2,825	846	(S)
Distribution by size of company [Based on number of employees]													
Less than 500..		7,163	963	6,200	458	(S)	(S)	921	219	(S)	1,849	(S)	(S)
500 to 999..		1,725	115	1,610	(S)	0	(S)	207	(S)	(S)	588	33	(S)
1,000 to 4,999..		7,262	981	6,281	447	92	356	1,291	228	1,063	2,911	215	2,696
5,000 to 9,999..		4,501	748	3,753	286	(D)	(D)	1,025	(D)	(D)	2,694	(S)	(S)
10,000 to 24,999..		12,043	2,362	9,681	420	(D)	(D)	2,436	(D)	(D)	4,695	1,027	3,668
25,000 or more..		59,461	25,583	33,878	1142	276	866	8,187	2,814	5,373	36,852	16,556	20,296

Industry and size of company		Not Distributed			Percent of Total Not Distributed		
		Total	Federal	Company	Total	Federal	Company
Total..		$25,632	$7,938	$17,694	27.8%	25.8%	28.8%
Distribution by industry							
Food, kindred, and tobacco products...............	20,21	(D)	(D)	256	(D)	(D)	21.3%
Textiles and apparel..................................	22,23	113	0	113	46.3%	0.0%	46.5%
Lumber, wood products, and furniture..............	24,25	47	0	47	34.3%	0.0%	34.3%
Paper and allied products..........................	26	267	0	268	44.2%	0.0%	44.4%
Chemicals and allied products.....................	28	3,005	8	2,997	31.2%	4.2%	31.7%
Industrial chemicals.............................	281-82,286	1,062	6	1,056	28.6%	3.2%	29.9%
Drugs and medicines..............................	283	1,425	2	1,423	34.8%	66.7%	34.7%
Other chemicals..................................	284-85,287-89	518	0	518	28.4%	0.0%	28.5%
Petroleum refining and extraction.................	13,29	605	0	606	31.9%	0.0%	32.2%
Rubber products......................................	30	374	0	374	61.8%	0.0%	62.8%
Stone, clay, and glass products...................	32	138	0	139	13.9%	0.0%	14.1%
Primary metals.......................................	33	183	3	180	25.1%	15.8%	25.3%
Ferrous metals and products......................	331-32,3398-99	119	0	119	46.9%	0.0%	47.8%
Nonferrous metals and products...................	333-36	64	2	61	13.4%	15.4%	13.2%

See footnotes at end of

Table A-3. Funds distributed for basic research, applied research, and development, by industry and size of company, by source of funds: 1987 (continued)

[Dollars in millions]

Industry and size of company		Not Distributed			Percent of Total Not Distributed		
Distribution by industry	SIC code	Total	Federal	Company	Total	Federal	Company
Fabricated metal products	34	$365	$54	$311	46.6%	36.0%	49.1%
Machinery	35	1,704	22	1,702	14.5%	1.8%	16.1%
Office, computing, and accounting machines	357	946	0	966	10.1%	0.0%	11.8%
Other machinery, except electrical	351-56,358-59	759	23	736	31.3%	52.3%	30.9%
Electrical equipment	36	3,912	1,134	2,778	24.7%	21.0%	26.6%
Radio and TV receiving equipment	365	128	0	128	92.1%	0.0%	92.1%
Communication equipment	366	1,797	952	845	17.6%	20.1%	15.5%
Electronic components	367	1,442	170	1,272	33.6%	25.9%	35.0%
Other electrical equipment	361-64,369	545	12	533	44.0%	85.7%	43.5%
Transportation equipment	37	8,691	5,692	3,000	25.4%	27.4%	22.3%
Motor vehicles and motor vehicles equipment	371	2,952	792	2,161	31.8%	37.4%	30.2%
Other transportation equipment	373-75,379	311	132	178	61.5%	88.6%	50.0%
Aircraft and missiles	372,376	5,430	4,769	661	22.2%	25.8%	11.1%
Professional and scientific instruments	38	2,837	125	2,712	54.3%	46.0%	54.8%
Scientific and mechanical measuring instruments	381-82	1,242	2	1,240	75.1%	3.6%	77.6%
Optical, surgical, photographic, and other instruments	383-87	1,595	123	1,472	44.7%	56.7%	43.9%
Other manufacturing industries	27,31,39	(D)	(D)	132	(D)	(D)	34.7%
Nonmanufacturing industries	10-11,14-17,40-42,44-51,53-54,56,60,62-63,72-73,78,806-07,87	2,977	896	2,081	38.0%	33.2%	40.5%
Distribution by size of company [Based on number of employees]							
Less than 500		3,935	464	3,471	54.9%	48.2%	56.0%
500 to 999		817	82	735	47.4%	71.3%	45.7%
1,000 to 4,999		2,613	446	2,166	36.0%	45.5%	34.5%
5,000 to 9,999		810	43	767	18.0%	5.7%	20.4%
10,000 to 24,999		4,492	1,238	3,254	37.3%	52.4%	33.6%
25,000 or more		12,966	5,665	7,301	21.8%	22.1%	21.6%

(D) Data have been withheld to avoid disclosing operations of individual companies.
(S) Data have been withheld due to imputation of more than 50 percent.

NOTE: Character-of-work data in this table represent only that fraction of total R&D funds for which there was a reported basis for distribution--they DO NOT represent universe estimates. The "Not Distributed" column shows those funds for which there was no basis for distribution.

SOURCE: National Science Foundation, SRS

Table A-4. Funds distributed for basic research, applied research, and development, by industry and size of company, by source of funds: 1988

[Dollars in millions]

Industry and size of company	SIC code	Total			Distributed funds								
		Total			Basic			Applied			Development		
		Total	Federal	Company	Total	Federal	Company	Total	Federal	Company	Total	Federal	Company
Total		$97,889	$32,306	$65,583	$2,852	$653	$2,199	$14,696	$3,542	$11,154	$52,764	$20,220	$32,544
Distribution by industry													
Food, kindred, and tobacco products	20,21	(D)	(D)	0	40	0	40	333	0	333	(D)	(D)	555
Textiles and apparel	22,23	(D)	(D)	210	(D)	0	(D)	(D)	0	(D)	(D)	(D)	88
Lumber, wood products, and furniture	24,25	(D)	(D)	0	(D)	0	(D)	(D)	0	(D)	(D)	(D)	60
Paper and allied products	26	(D)	(D)	664	31	0	31	(D)	(D)	139	225	0	225
Chemicals and allied products	28	10,772	199	10,573	554	12	542	2,986	106	2,880	3,789	78	3,711
Industrial chemicals	281-82,286	3,959	196	3,763	213	12	201	(D)	(D)	1,011	(D)	(D)	1,396
Drugs and medicines	283	4,746	3	4,743	(S)	0	(S)	(D)	(D)	1,244	(D)	(D)	1,482
Other chemicals	284-85,287-89	2,067	0	2,067	37	0	37	624	0	624	833	0	833
Petroleum refining and extraction	13,29	1,944	21	1,923	(D)	(D)	67	(D)	(D)	686	579	5	574
Rubber products	30	(D)	(D)	0	20	0	20	(D)	(D)	45	(D)	(D)	154
Stone, clay, and glass products	32	(D)	(D)	0	150	0	150	(D)	(D)	(S)	212	1	211
Primary metals	33	663	21	642	58	0	58	(D)	(D)	161	(D)	(D)	257
Ferrous metals and products	331-32,3398-99	258	1	257	2	0	2	(D)	(D)	71	(D)	(D)	71
Nonferrous metals and products	333-36	405	20	385	56	0	56	(D)	(D)	91	(D)	(D)	186
Fabricated metal products	34	829	142	687	29	0	29	(D)	(D)	79	(D)	(D)	248
Machinery	35	(D)	(D)	11,992	(D)	(D)	205	(D)	(D)	1,696	(D)	(D)	8,004
Office, computing, and accounting machines	357	(D)	(D)	9,371	(D)	(D)	144	(D)	(D)	1,393	(D)	(D)	6,706
Other machinery, except electrical	351-56,358-59	2,719	98	2,621	61	0	61	(D)	(D)	303	(D)	(D)	1,298
Electrical equipment	36	16,242	5,369	10,873	412	21	391	2,757	811	1,946	9,152	3,432	5,720
Radio and TV receiving equipment	365	139	0	139	(D)	0	(D)	(D)	0	(D)	(D)	0	(D)
Communication equipment	366	10,296	4,621	5,675	(D)	20	(D)	1,185	(D)	(D)	7,111	(D)	(D)
Electronic components	367	4,607	728	3,879	(D)	(D)	(S)	(D)	(D)	1,144	(D)	(D)	1,324
Other electrical equipment	361-64,369	1,200	20	1,180	63	0	(S)	110	0	110	461	10	451
Transportation equipment	37	36,338	22,176	14,162	349	197	152	2,852	1,531	1,321	23,281	14,592	8,689
Motor vehicles and motor vehicles equipment	371	(D)	(D)	0	(D)	0	(D)	(D)	(D)	(D)	(D)	(D)	(D)
Other transportation equipment	373-75,379	(D)	(D)	0	(D)	0	(D)	(D)	(D)	(D)	(D)	(D)	(D)
Aircraft and missiles	372,376	25,900	19,877	6,023	276	197	79	2,262	1,437	825	16,982	13,282	3,700

See footnotes at end of

Table A-4. Funds distributed for basic research, applied research, and development, by industry and size of company, by source of funds: 1988 (continued)

[Dollars in millions]

					Distributed funds								
Industry and size of company		Total			Basic			Applied			Development		
Distribution by industry	SIC code	Total	Federal	Company	Total	Federal	Company	Total	Federal	Company	Total	Federal	Company
Professional and scientific instruments	38	$5,426	$121	$5,305	(D)	(D)	$218	(D)	(D)	$549	$1,717	$80	$1,637
Scientific and mechanical measuring instruments	381-82	1,734	(S)	1,734	$34	$0	34	(D)	(D)	57	(D)	(D)	262
Optical, surgical, photographic, and other instruments	383-87	3,692	97	3,595	(D)	(D)	184	(D)	(D)	492	(D)	(D)	1,375
Other manufacturing industries	27,31,39	(D)	(D)	0	0	0	0	$31	$0	31	212	0	212
Nonmanufacturing industries	10-11,14-17,40-42,44-51,53-54,56,60,62-63,72-73,78,806-07,87	8,113	2,753	5,360	662	414	248	1,443	589	854	3,171	973	2,198
Distribution by size of company [Based on number of employees]													
Less than 500		(S)	864	(S)	340	121	219	781	191	590	1,425	72	1,353
500 to 999		1,656	139	1,517	100	0	100	232	1	231	732	(S)	685
1,000 to 4,999		7,598	1,157	6,441	471	108	363	1,586	303	1,283	3,810	477	3,333
5,000 to 9,999		5,236	914	4,322	194	(D)	(D)	1,055	(D)	(D)	2,539	593	1,946
10,000 to 24,999		11,473	1,805	9,668	477	(D)	(D)	2,756	(D)	(D)	5,201	(S)	3,934
25,000 or more		64,678	27,428	37,249	1270	420	850	8,286	2,764	5,522	39,057	17,764	21,293

		Not Distributed			Percent of Total Not Distributed		
Industry and size of company		Total	Federal	Company	Total	Federal	Company
Total		$27,577	$7,891	$19,686	28.2%	24.4%	30.0%
Distribution by industry							
Food, kindred, and tobacco products	20,21	264	0	264	22.1%	0.0%	22.1%
Textiles and apparel	22,23	106	1	105	49.8%	33.3%	50.0%
Lumber, wood products, and furniture	24,25	51	0	51	32.5%	0.0%	32.7%
Paper and allied products	26	269	0	269	40.5%	0.0%	40.5%
Chemicals and allied products	28	3,443	3	3,440	32.0%	1.5%	32.5%
Industrial chemicals	281-82,286	1,156	1	1,155	29.2%	0.5%	30.7%
Drugs and medicines	283	1,715	2	1,713	36.1%	66.7%	36.1%
Other chemicals	284-85,287-89	573	0	573	27.7%	0.0%	27.7%
Petroleum refining and extraction	13,29	608	12	596	31.3%	57.1%	31.0%
Rubber products	30	416	0	416	64.3%	0.0%	65.5%
Stone, clay, and glass products	32	68	0	68	8.1%	0.0%	8.2%
Primary metals	33	166	0	166	25.0%	0.0%	25.9%
Ferrous metals and products	331-32,3398-99	113	0	113	43.8%	0.0%	44.0%
Nonferrous metals and products	333-36	54	2	52	13.3%	10.0%	13.5%

See footnotes at end of

Table A-4. Funds distributed for basic research, applied research, and development, by industry and size of company, by source of funds: 1988 (continued)

[Dollars in millions]

Industry and size of company		Not Distributed			Percent of Total Not Distributed		
Distribution by industry	SIC code	Total	Federal	Company	Total	Federal	Company
Fabricated metal products	34	$379	$48	$331	45.7%	33.8%	48.2%
Machinery	35	2,158	71	2,087	16.0%	4.8%	17.4%
Office, computing, and accounting machines	357	1,128	0	1,128	10.5%	0.0%	12.0%
Other machinery, except electrical	351-56,358-59	1,030	71	959	37.9%	72.4%	36.6%
Electrical equipment	36	3,921	1,105	2,816	24.1%	20.6%	25.9%
Radio and TV receiving equipment	365	126	0	126	90.6%	0.0%	90.6%
Communication equipment	366	1,751	934	817	17.0%	20.2%	14.4%
Electronic components	367	1,477	161	1,316	32.1%	22.1%	33.9%
Other electrical equipment	361-64,369	566	10	556	47.2%	50.0%	47.1%
Transportation equipment	37	9,856	5,856	4,000	27.1%	26.4%	28.2%
Motor vehicles and motor vehicles equipment	371	3,159	773	2,386	31.8%	35.8%	30.7%
Other transportation equipment	373-75,379	317	122	195	62.0%	86.5%	52.7%
Aircraft and missiles	372,376	6,380	4,961	1,419	24.6%	25.0%	23.6%
Professional and scientific instruments	38	2,917	16	2,901	53.8%	13.2%	54.7%
Scientific and mechanical measuring instruments.	381-82	1,362	5	1,357	78.5%	20.8%	79.4%
Optical, surgical, photographic, and other instruments	383-87	1,555	11	1,544	42.1%	11.3%	42.9%
Other manufacturing industries	27,31,39	(D)	(D)	140	36.7%	100.0%	36.6%
Nonmanufacturing industries	10-11,14-17,40-42,44-51,53-54,56,60,62-63,72-73,78,806-07,87	2,837	777	2,060	35.0%	28.2%	38.4%
Distribution by size of company [Based on number of employees]							
Less than 500		4,703	480	4,223	64.9%	55.6%	66.1%
500 to 999		592	91	501	35.7%	65.5%	33.0%
1,000 to 4,999		1,731	269	1,462	22.8%	23.2%	22.7%
5,000 to 9,999		1,448	158	1,290	27.7%	17.3%	29.8%
10,000 to 24,999		3,039	413	2,626	26.5%	22.9%	27.2%
25,000 or more		16,065	6,480	9,584	24.8%	23.6%	25.7%

(D) Data have been withheld to avoid disclosing operations of individual companies.
(S) Data have been withheld due to imputation of more than 50 percent.

NOTE: Character-of-work data in this table represent only that fraction of total R&D funds for which there was a reported basis for distribution--they DO NOT represent universe estimates. The "Not Distributed" column shows those funds for which there was no basis for distribution.

SOURCE: National Science Foundation, SRS

Table A-5. Funds distributed for basic research, applied research, and development, by industry and size of company, by source of funds: 1989

[Dollars in millions]

		Distributed funds											
		Total			Basic			Applied			Development		
Industry and size of company	SIC code	Total	Federal	Company	Total	Federal	Company	Total	Federal	Company	Total	Federal	Company
Total		$101,599	$31,366	$70,233	$2,992	$837	$2,155	$17,356	$3,665	$13,691	$55,555	$17,948	$37,607
Distribution by industry													
Food, kindred, and tobacco products	20,21	(D)	(D)	1,283	19	0	19	(D)	(D)	368	(D)	(D)	622
Textiles and apparel	22,23	(D)	(D)	(S)	(D)	(D)	(D)	(S)	0	(S)	(D)	(D)	(S)
Lumber, wood products, and furniture	24,25	170	0	170	(D)	0	(D)	39	0	39	68	0	68
Paper and allied products	26	683	0	683	29	0	29	121	0	121	323	0	323
Chemicals and allied products	28	11,537	87	11,450	534	8	526	3,350	(S)	3,333	4,118	57	4,061
Industrial chemicals	281-82,286	4,056	84	3,972	227	8	219	(D)	(D)	1,095	1,516	57	1,460
Drugs and medicines	283	(D)	(D)	5,206	(S)	0	(S)	(D)	(D)	1,378	(D)	(D)	1,629
Other chemicals	284-85,287-89	(D)	(D)	2,271	33	0	33	(D)	(D)	860	(D)	(D)	972
Petroleum refining and extraction	13,29	2,066	(S)	2,050	(D)	(D)	72	673	1	672	653	3	650
Rubber products	30	(D)	(D)	679	17	0	17	(D)	(D)	81	(D)	(D)	191
Stone, clay, and glass products	32	(D)	(D)	861	(D)	(D)	170	(D)	(D)	394	(D)	(D)	245
Primary metals	33	768	34	734	(S)	0	(S)	(D)	(D)	199	341	20	321
Ferrous metals and products	331-32,3398-99	(D)	(D)	270	(D)	0	(D)	(D)	(D)	83	(D)	(D)	81
Nonferrous metals and products	333-36	(D)	(D)	463	(D)	0	(D)	(D)	(D)	(S)	(D)	(D)	240
Fabricated metal products	34	788	135	653	23	0	23	(D)	(D)	109	376	75	301
Machinery	35	(D)	(D)	13,216	(D)	(D)	(S)	(D)	(D)	2,722	(D)	(D)	(S)
Office, computing, and accounting machines	357	(D)	(D)	10,533	(D)	(D)	(S)	(D)	(D)	2,220	(D)	(D)	(S)
Other machinery, except electrical	351-56,358-59	2,789	106	2,683	50	0	50	509	7	502	1,730	19	1,711
Electrical equipment	36	16,768	5,222	11,546	378	10	368	2,894	568	2,326	10,001	3,442	6,559
Radio and TV receiving equipment	365	85	0	85	(S)	0	(S)	(D)	0	(D)	(D)	0	(D)
Communication equipment	366	10,508	4,666	5,842	(D)	(D)	(D)	1,161	(D)	(D)	7,341	3,158	4,183
Electronic components	367	4,884	522	4,362	(D)	(D)	39	(D)	(D)	1,387	(D)	(D)	1,720
Other electrical equipment	361-64,369	1,292	35	1,257	(D)	0	(D)	215	0	215	(D)	(D)	(D)
Transportation equipment	37	36,863	21,763	15,100	478	336	142	3,129	1,668	1,461	22,475	12,665	9,810
Motor vehicles and motor vehicles equipment	371	(D)	(D)	8,726	(D)	0	(D)	(D)	(D)	(D)	(D)	(D)	(D)
Other transportation equipment	373-75,379	(D)	(D)	354	(D)	0	(D)	(D)	(D)	(D)	(D)	(D)	(D)
Aircraft and missiles	372,376	25,654	19,634	6,020	413	336	77	2,444	1,576	868	15,700	11,480	4,220

See footnotes at end of

Table A-5. Funds distributed for basic research, applied research, and development, by industry and size of company, by source of funds: 1989 (continued)

[Dollars in millions]

Industry and size of company		Total			Distributed funds								
					Basic			Applied			Development		
Distribution by industry	SIC code	Total	Federal	Company	Total	Federal	Company	Total	Federal	Company	Total	Federal	Company
Professional and scientific instruments	38	$5,763	$125	$5,638	(D)	(D)	$196	$688	$21	$667	(D)	(D)	$1,991
Scientific and mechanical measuring instruments.	381-82	1,868	10	1,858	(S)	$0	(S)	(D)	(D)	106	(D)	(D)	390
Optical, surgical, photographic, and other instruments	383-87	3,895	115	3,780	(D)	(D)	172	(D)	(D)	561	(D)	(D)	1,601
Other manufacturing industries	27,31,39	(D)	(D)	402	$28	0	28	(D)	(D)	51	(D)	(D)	249
Nonmanufacturing industries	10-11,14-17,40-42,44-51,53-54,56,60,62-63,72-73,78,806-07,87	8,273	2,716	5,557	720	466	254	1,881	768	1,113	$4,348	$1,022	3,326
Distribution by size of company [Based on number of employees]													
Less than 500		7,446	940	(S)	361	141	220	(S)	(S)	(S)	(S)	(S)	(S)
500 to 999		1,718	105	1,613	108	0	108	438	(S)	437	945	(S)	924
1,000 to 4,999		7,843	1,113	6,730	421	(D)	(D)	1,510	273	1,237	4,175	450	3,725
5,000 to 9,999		6,545	813	5,732	142	(D)	(D)	1,330	190	1,140	2,125	499	1,626
10,000 to 24,999		10,432	1,245	9,187	515	(D)	(D)	3,155	336	2,819	5,320	(S)	4,829
25,000 or more		67,615	27,150	40,465	1445	556	889	9,074	2,516	6,558	38,533	16,189	22,343

Industry and size of company		Not Distributed			Percent of Total Not Distributed		
		Total	Federal	Company	Total	Federal	Company
Total		$25,696	$8,916	$16,780	25.3%	28.4%	23.9%
Distribution by industry							
Food, kindred, and tobacco products	20,21	274	0	274	21.3%	0.0%	21.4%
Textiles and apparel	22,23	54	0	54	25.2%	0.0%	25.5%
Lumber, wood products, and furniture	24,25	46	0	46	27.1%	0.0%	27.1%
Paper and allied products	26	210	0	210	30.7%	0.0%	30.7%
Chemicals and allied products	28	3,535	5	3,530	30.6%	5.7%	30.8%
Industrial chemicals	281-82,286	1,203	4	1,198	29.7%	4.8%	30.2%
Drugs and medicines	283	1,926	1	1,925	37.0%	25.0%	37.0%
Other chemicals	284-85,287-89	406	0	406	17.9%	0.0%	17.9%
Petroleum refining and extraction	13,29	667	11	656	32.3%	68.8%	32.0%
Rubber products	30	390	0	390	56.5%	0.0%	57.4%
Stone, clay, and glass products	32	52	0	52	5.9%	0.0%	6.0%
Primary metals	33	147	0	147	19.1%	0.0%	20.0%
Ferrous metals and products	331-32,3398-99	104	0	103	38.2%	0.0%	38.1%
Nonferrous metals and products	333-36	43	0	43	8.7%	0.0%	9.3%

See footnotes at end of

Table A-5. Funds distributed for basic research, applied research, and development, by industry and size of company, by source of funds: 1989 (continued)

[Dollars in millions]

Industry and size of company Distribution by industry	SIC code	Not Distributed Total	 Federal	 Company	Percent of Total Not Distributed Total	 Federal	 Company
Fabricated metal products	34	$267	$47	$220	33.9%	34.8%	33.7%
Machinery	35	1,579	80	1,499	10.9%	6.5%	11.3%
Office, computing, and accounting machines	357	1,079	0	1,079	9.3%	0.0%	10.2%
Other machinery, except electrical	351-56,358-59	500	80	420	17.9%	75.5%	15.7%
Electrical equipment	36	3,495	1,202	2,293	20.8%	23.0%	19.9%
Radio and TV receiving equipment	365	51	0	51	60.0%	0.0%	60.0%
Communication equipment	366	1,742	1,055	687	16.6%	22.6%	11.8%
Electronic components	367	1,350	134	1,216	27.6%	25.7%	27.9%
Other electrical equipment	361-64,369	355	14	341	27.5%	40.0%	27.1%
Transportation equipment	37	10,781	7,094	3,687	29.2%	32.6%	24.4%
Motor vehicles and motor vehicles equipment	371	3,461	799	2,662	32.1%	38.8%	30.5%
Other transportation equipment	373-75,379	224	52	172	53.2%	77.6%	48.6%
Aircraft and missiles	372,376	7,097	6,242	855	27.7%	31.8%	14.2%
Professional and scientific instruments	38	2,798	14	2,784	48.6%	11.2%	49.4%
Scientific and mechanical measuring instruments	381-82	1,342	4	1,338	71.8%	40.0%	72.0%
Optical, surgical, photographic, and other instruments	383-87	1,456	10	1,446	37.4%	8.7%	38.3%
Other manufacturing industries	27,31,39	74	0	74	18.4%	0.0%	18.4%
Nonmanufacturing industries	10-11,14-17,40-42,44-51,53-54,56,60,62-63,72-73,78,806-07,87	1,324	460	864	16.0%	16.9%	15.5%
Distribution by size of company [Based on number of employees]							
Less than 500		780	152	628	10.5%	16.2%	9.7%
500 to 999		227	83	144	13.2%	79.0%	8.9%
1,000 to 4,999		1,737	(D)	(D)	22.1%	(D)	(D)
5,000 to 9,999		2,948	(D)	(D)	45.0%	(D)	(D)
10,000 to 24,999		1,442	(D)	(D)	13.8%	(D)	(D)
25,000 or more		18,563	7,889	10,675	27.5%	29.1%	26.4%

(D) Data have been withheld to avoid disclosing operations of individual companies.
(S) Data have been withheld due to imputation of more than 50 percent.

NOTE: Character-of-work data in this table represent only that fraction of total R&D funds for which there was a reported basis for distribution--they DO NOT represent universe estimates. The "Not Distributed" column shows those funds for which there was no basis for distribution.

SOURCE: National Science Foundation, SRS

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Table A-6. Funds distributed for basic research, by industry, by field of science and engineering: 1989

[Dollars in millions]

Industry	SIC Code	Total	Physical sciences	Mathematics	Computer sciences	Enivronmental sciences	Engineering (including metallurgy)	Life sciences	Other sciences
Total	....	$2,992	$780	(S)	(S)	$17	$674	$416	(S)
Food, kindred, and tobacco products	20,21	19	7	(D)	(D)	(D)	1	10	(D)
Textiles and apparel	22,23	(D)	(D)	0	0	0	(D)	0	0
Lumber, wood products, and furniture	24,25	(D)	0	0	0	0	(D)	0	(D)
Paper and allied products	26	29	1	0	0	0	(D)	(D)	(D)
Chemicals and allied products	28	534	255	6	(1)	3	14	(S)	(S)
Industrial chemicals	281-82,286	227	145	6	0	3	13	60	0
Drugs and medicines	283	(S)	(S)	0	0	0	0	(S)	(S)
Other chemicals	284-85,287-89	33	17	0	(1)	0	1	14	(1)
Petroleum refining	29	(D)	37	(D)	(D)	(D)	(D)	(D)	(D)
Rubber products	30	17	4	0	0	0	13	0	0
Stone, clay, and glass products	32	(D)	119	(D)	0	0	40	(D)	(D)
Primary metals	33	(S)	(S)	(D)	(D)	(D)	(S)	0	(S)
Ferrous metals and products	331-32,3398-99	(D)	0	0	0	0	(D)	0	(D)
Nonferrous metals and products	333-36	(D)	(S)	(D)	(D)	(D)	(D)	0	(D)
Fabricated metal products	34	23	(D)	0	0	0	21	0	(D)
Machinery	35	(D)	(D)	(D)	(S)	0	69	(D)	2
Office, computing, and accounting machines	357	(D)	(D)	(D)	(S)	0	(S)	(D)	2
Other machinery, except electrical	351-56,358-59	50	0	0	0	0	48	0	0
Electrical equipment	36	378	101	(D)	66	(D)	119	(S)	15
Radio and TV receiving equipment	365	(S)	0	0	0	0	(S)	0	0
Communication equipment	366	(D)	(D)	(D)	57	(D)	(D)	0	(D)
Electronic components	367	(D)	8	0	(D)	0	9	(D)	(D)
Other electrical equipment	361-64,369	(D)	(D)	0	(D)	0	(D)	(D)	(S)
Transportation equipment	37	478	109	(D)	(S)	(S)	271	(D)	(D)
Motor vehicles and moto- vehicles equipment	371	(D)	(D)	(D)	0	(D)	(D)	0	(D)
Other transportation equipment	373-75,379	(D)	(D)	(D)	(D)	(D)	(D)	0	0
Aircraft and missiles	372,376	413	103	(D)	(D)	(D)	218	(D)	(D)

See footnotes at end of

Table A-6. Funds distributed for basic research, by industry, by field of science and engineering: 1989 (continued)

[Dollars in millions]

Industry	SIC Code	Total	Physical sciences	Mathematics	Computer sciences	Enivron-mental sciences	Engineering (including metallurgy)	Life sciences	Other sciences
Professional and scientific instruments....	38	(D)	(S)	0	0	0	(S)	(S)	(D)
Scientific and mechanical measuring instruments..............................	21,27,31,39 381-82	(S)	(S)	0	0	0	(S)	0	(S)
Optical, surgical, photographic, and other instruments..............................	383-87	(D)	(S)	0	0	0	(S)	(S)	(D)
Other manufacturing industries.............	27,31,39	28	22	(1)	2	0	1	3	0
Nonmanufacturing industries...................	10-11,14-17,40-42,44-51,53-54,56,60,62-63,72-73,78,806-07,87	721	(S)	(S)	(S)	(S)	(S)	(S)	(S)

(D) Data have been withheld to avoid disclosing operations of individual companies.
(S) Data have been withheld due to imputation of 50 percent or more.
(1) Less than $0.5 million.

NOTE: Data in this table represent only that fraction of total R&D funds for which there was a reported basis for distribution--they DO NOT represent universe estimates of expenditures for industrial basic research.

SOURCE: National Science Foundation, SRS.

Comparability of Data Over A Period of Several Years

Several procedures are undertaken to revise data and maintain the reliability of the time series data of industrial R&D:

Two-Year Comparability

Before the survey forms are mailed each year, Census imprints the data reported by the respondent the previous year (or two years earlier for items asked only in odd-numbered years.) Respondents are asked to adjust data for the previous year(s) if necessary to make them comparable to data provided for the current year. Such adjustments are necessitated by any of several developments, e.g., changes in company structure such as mergers, acquisitions, or divestitures; changes in reporting concepts; and even correction of any errors that may have been made previously. Thus, there is comparability in the reporting of survey data over any 2-year period.

These adjustments can be examined by comparing data for the same year reported in two succeeding periods, e.g., 1988 data appearing in the 1988 edition of Research and Development in Industry may differ from 1988 data in this volume. Totals for broad classifications are likely to be very close in the two editions; differences may be more noticeable in the finer detail. These differences underscore the point that the measures are approximate and indicative rather than precise.

Historical Data Revisions

The published industry R&D survey data are revised periodically, usually because of changes in the SIC code classifications of companies. In addition, two other major data revisions were made in the data for the 1981-87 periods. The revisions are explained below:

Companies may shift from one SIC code into another because of any of the following: (1) The growth and/or decline of product lines, (2) the merger of two or more companies, (3) the acquisition of one company by another, (4) divestiture, or (5) the formation of conglomerates. When Census staff are aware of the year in which changes #2, #3, #4, or #5 occurred [respondents are asked on the questionnaire about changes in ownership], they reclassify that firm's data into the new industry for the year the change actually occurred. If a change is not discovered until the new sample is selected or if it cannot be determined when a shift actually occurred (i.e., #1), other methodologies are used to adjust, or "backcast," the data to reflect the move of a company out of one industry and into another. Since 1967, three revisions were made in the data, covering the periods 1967-76, 1976-81, and 1981-87.

1. The 1967-76 Period

The SIC codes assigned to companies in the panel for the years 1967 through 1975 were based on data reported in the 1967 economic census. The 1974 SSEL file was used to assign SIC codes to companies in the next panel chosen for the 1976 survey. These codes were used to revise 1975 data received in the 1976 survey. The SIC codes of companies in the 1967 and 1976 panels were examined to determine which companies had changed classifications. Since it was not known in which year changes actually occurred, data of companies that had changed SIC codes were revised for the years 1968 through 1974 to smooth the changes over the period 1967-76. To illustrate, if a company was originally in SIC A in 1967 but was discovered to be in SIC B in 1974, its data for 1967-74 were allocated between the two industries as follows: 1967--all of the company's data were retained in industry A; 1968--14.3 percent of the company's data was allocated to industry B, and the remainder retained in industry A; 1969--28.6 percent was allocated to industry B, and the remainder retained in industry A; and so on until 1974, when all of the company's data were allocated to industry B.

2. The 1976-81 Period

"Backcasting" revisions in the industry R&D data for 1976-80 were also made to reflect the classification changes revealed in the new sample drawn in 1981; however, a different methodology was used for the revisions.

When the new panel was selected in 1981, companies were assigned SIC codes from the 1981 SSEL and the 1981 Enterprise Files. Prior-period (1980) data were collected in the 1981 survey. These data were presumed to be more accurate than those collected in the 1980 survey because they not only reflected updated SIC code classifications, but also were obtained from a larger panel providing better coverage of U.S. industry. Data obtained for 1976-80 using the panel selected in 1976 were revised subject to the following constraints:

a. Data for 1976, revised from the 1977 survey would remain unchanged since this was the first year the 1976 panel was used, and since that panel was an accurate reflection of company SIC codes in 1976.

b. Data for 1980 collected in the 1981 survey would be used instead of the 1980 data collected in the 1980 survey.

An algorithm was used to link data from 1976 with those collected in 1981, preserving, to the greatest extent possible, year-to-year trends in data for each industry by revising data for the years 1977, 1978, and 1979.

The following data elements were adjusted using the methodologies just described: Funds spent on R&D (total, Federal, company and other, and R&D performed outside the U.S.); number of FTE R&D scientists and engineers; total and company and other R&D funds as a percent of net sales; and cost per R&D scientist or engineer. No adjustments were made in other data elements.

3. The 1981-86 Period

Similar "backcasting" revisions in the industry R&D data were made in 1987 for the industry data previously reported for the years 1981-86. Several other adjustments were made in 1987 in addition to the original methodology described for the revisions made in 1981.

When the 1987 sample was selected, companies were assigned SIC codes from the 1987 SSEL File. Companies in the sample were asked to submit their prior-year (1986) data along with the information collected for the 1987 survey. These "new" 1986 data were used in lieu of the data originally collected in the 1986 survey because they reflected updated SIC code classifications of companies, and also were collected from a much larger sample that was designed to provide better coverage of U.S. industry, particularly the nonmanufacturing portion. Data obtained for 1981-86 using the panel selected in 1981 were revised in 1987 subject to the following constraints:

a. Data for 1981, revised from the 1982 survey, would remain unchanged since this was the first year the 1981 panel was used, and since that panel was an accurate reflection of company SIC codes in that year.

b. Data for 1986 collected in the 1987 survey would be used instead of the 1986 data collected in the 1986 survey.

There was an increase of $9,265 million between the 1986 data based on the old panel, and the 1986 data reported by the new panel identified in 1987. Most of that aggregate revision was caused by the addition of new R&D performing firms identified through the revised sampling procedures in 1987. An algorithm was used to link data from 1981 with those collected in 1987, preserving to the greatest extent possible, year-to-year trends that had previously been reported in data for each industry by revising data for the years 1982, 1983, 1984, and 1985. Interested persons should contact Census to obtain further information about the construction and content of the algorithm.

4. Federal Data for 1986

Data for a merger between two companies was incorrectly processed in the 1988 tabulations resulting in an overcount of Federal R&D support for industry in the amount of $356 million in

1986. The corrected 1986 industry R&D total (company, Federal, and other funds) is $87,823, and the Federal total is $27,891 million. These corrections are reflected in tables B-1, B-3, and B-13 of this report. No revisions to published 1988 individual industry data were necessary because data for the affected industry were suppressed to avoid possible disclosure of information about operations of individual companies (i.e., these data cells are marked with the symbol "D").

5. Data Reevaluations for 1987

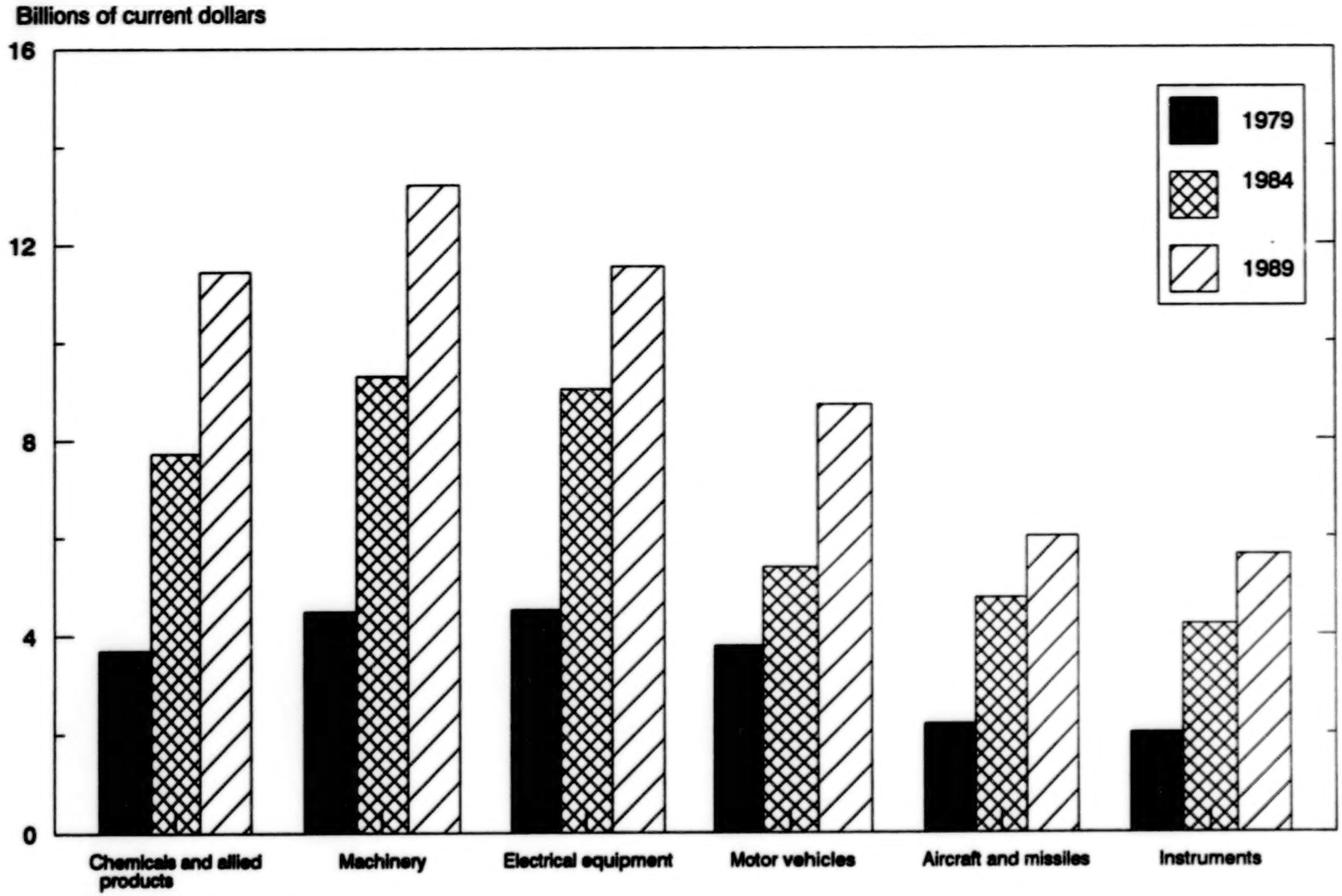
Many of the small firms identified in the 1987 sample were receiving this kind of form for the first time, and some were not accustomed to reporting financial information rounded to the nearest thousand dollars. Several of these firms, therefore, mistakenly reported their expenditures for R&D in dollars, not thousands of dollars as requested. Consequently, several firms were selected for the 1987 panel based on an incorrectly reported size of their R&D program. Many of these firms realized their error when they received the 1988 form with the pre-printed 1987 data. The respondents corrected their 1987 data when they submitted the 1988 forms.

Furthermore, several of these firms reported, in 1988, that they had no R&D program even though they had previously reported expenditures for R&D activities in the 1987 survey. Following verification of no R&D activity by telephone, Census staff declared these firms to be out-of-scope and blanked the erroneous information from the 1987 estimates during processing of the survey results in 1988.

Similar reporting errors were encountered during the 1989 data collection and processing. In addition, review of the 1989 estimates revealed an error in the revision procedure used for firms discovered to be out-of-scope in 1988. This error resulted in only a partial correction for these firms during the 1988 processing. These errors caused Census to take the unusual step of revising the 1987 R&D expenditure estimate this year. (Revisions to data two-years back is rarely done, except during sample years when historical adjustments are made to account for shifts in industrial classification.)

Based on all the adjustments listed above, chart 2 depicts trends in company R&D expenditures for individual industries.

Chart 2. Company and other (except Federal) funds for R&D performance by selected industry



SOURCE: National Science Foundation, SRS

Survey Definitions[5]

Research and development--Basic and applied research in the sciences and engineering and the design and development of prototypes and processes. This definition excludes quality control, routine product testing, market research, sales promotion, sales service, other nontechnological activities or routine technical services, and research in the social sciences or psychology.

Basic research--Original investigations for the advancement of scientific knowledge not having specific immediate commercial objectives, although such investigations may be in fields of present or potential interest to the reporting company.

Applied research--Investigations for the discovery of new scientific knowledge having specific commercial objectives with respect to products or processes. This definition differs from that of basic research chiefly in terms of the objectives of the reporting company.

Development--Technical activities of a nonroutine nature concerned with translating research findings or other scientific knowledge into products or processes. Not included are routine technical services to customers or other activities excluded from the foregoing definition of R&D.

See next subsection, **Explanation of Tabular Data,** for a discussion of the format in which these data are being published.

Full-time-equivalent (FTE)--The number of scientists and engineers in the company who are assigned full time to R&D projects together with the fraction of total work time spent on R&D projects by non-full-time R&D scientists and engineers.

Funds for R&D--Operating expenses incurred by a company in the conduct of R&D in its own laboratories or other company-owned or -operated facilities. These expenses include wages and salaries, materials and supplies consumed, property and other taxes, maintenance and repairs, depreciation, and an appropriate share of overhead, but exclude capital expenditures. Except where indicated in table B-1, all funds for R&D performance are expressed in current, rather than constant, dollars.

Company (and other) funds for R&D--Cost of R&D actually performed within the company, and funded by the company itself or by other non-Federal sources via contract. These data therefore do not include the cost of R&D supported by companies but contracted to outside organizations, such as research institutions, universities and colleges, nonprofit organizations, or (to avoid double-counting) other companies. Since it is a survey of R&D performers, industrial firms that undertake R&D supported by outside organizations do report the funds received in payment for the R&D work they perform. These monies are classified under the industries of the performing companies.

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[5] See section D for more detailed definitions and the instruction sheet sent to survey respondents.

Federal funds for R&D--Represents receipts for R&D performed by the company on Federal R&D contracts or subcontracts and R&D portions of procurement contracts and subcontracts.

Federally funded research and development centers (FFRDCs)--R&D-performing organizations administered by industrial, educational, or other institutions on a nonprofit basis, exclusively or substantially financed by the Federal Government. FFRDCs are supported by the Federal Government either to meet a particular R&D objective or, in some instances, to provide major facilities at universities for research and associated training purposes. R&D expenditures of the FFRDCs that are industry-administered are included with the Federal R&D data of the industry classification of each of the administering firms.

R&D scientists and engineers--The January number of those engaged full time in R&D and the full-time equivalent of those working part time in R&D. Scientists and engineers are defined as persons engaged in scientific or engineering work at a level that requires knowledge of physical, life, engineering, or mathematical science equivalent at least to that acquired through completion of a 4-year college program with a major in one of those fields.

Employment--Total number of persons domestically employed by R&D-performing companies in all activities during the pay period that includes the 12th of March. These data are not completely comparable with the data on R&D scientists and engineers described in the foregoing paragraph because the earlier data are collected for January of each year.

Net sales and receipts--Recorded dollar values for goods sold or services rendered by R&D-performing companies to customers (outside the company), including the Federal Government, less such items as returns, allowances, freight, charges, and excise taxes. Domestic intracompany transfers and sales by foreign subsidiaries are excluded, but transfers to foreign subsidiaries and export sales to foreign companies are included.

Geographic area covered--Includes only those operations located in the 50 States and the District of Columbia.[6]

Explanation of Tabular Data

Classification of reporting units--The basic reporting unit is the company or corporate family that includes all establishments under common ownership or control. All R&D expenditures and all scientists and engineers of each company are classified into a single SIC code and size-category.[7]

Industry classification--Census staff assigned an enterprise-level SIC code to each company. A single SIC code was assigned to multi-establishment companies based on the code which represented the most dominant aggregated activity for that firm (in terms of total payroll.)[8] Data for the following industry groupings [with SIC code(s) shown in parentheses[9]] are published in this report:

Food and tobacco (20,21)[10]
Textiles and apparel (22,23)
Lumber, wood products, and furniture (24,25)
Paper and allied products (26)

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[6] Company-sponsored R&D performed outside the United States by foreign subsidiaries of U.S. domestic companies is reported in table B-10 but excluded from all other tables.

[7] An exception was made for most of the companies classified in SIC code 13 (oil and gas extraction) and SIC code 50 (wholesale trade, durable goods). Because the R&D activity of these companies is in manufacturing product areas rather than service areas, their R&D expenditures were included with the SIC classifications of the manufacturing codes which encompassed the highest dollar-value of their payroll. The R&D of all such firms in SIC 13 were included with the firms in SIC 29 (petroleum). There were several manufacturing SIC codes that received the R&D expenditures of these types of firms in SIC 50.

[8] See footnote #7.

[9] When the sample was drawn in 1987, the 1972 SIC code numbers were in effect. For the convenience of researchers who may want to cross-reference these data with current data from other sources, the stubs of the tables contain the 1987 SIC codes. Thus, in table B-1, research and development laboratories are listed under the 2-digit SIC code 87, although they carried an SIC code of 73 when they were originally selected.

[10] Until 1984, tobacco products (SIC 21) was included with "other manufacturing industries."

- Chemicals and allied products (28)
  - Industrial chemicals (281-82,286)
  - Drugs and medicines (283)
  - Other chemicals (284-85,287-89)
- Petroleum refining and extraction (13,29)
- Rubber products (30)
- Stone, clay, and glass products (32)
- Primary metals (33)
  - Ferrous metals and products (331-32,3398-99)
  - Nonferrous metals and products (333-36)
- Fabricated metal products (34)
- Machinery (35)
  - Office, computing, and accounting machines (357)
  - Other machinery, except electrical (351-56,358-59)
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  - Radio and TV receiving equipment (365)
  - Communication equipment (366)
  - Electronic components (367)
  - Other electrical equipment (361-64,369)
- Transportation equipment (37)
  - Motor vehicles and motor vehicles equipment (371)
  - Other transportation equipment (373-75,379)
  - Aircraft and missiles (372,376)[11]
- Professional and scientific instruments (38)
  - Scientific and mechanical measuring instruments (381-82)
  - Optical, surgical, photographic, and other instruments (383-87)
- Other manufacturing industries--printing and publishing (27), leather products (31), and miscellaneous manufacturing industries (39)[12]
- Nonmanufacturing industries--mining (10-11,14); construction (15-17); transportation, communications, electric, gas, and sanitary services (40-42,44-49); wholesale and retail trade (50-51,53-54,56); finance, insurance, and real estate (60,62-63); personal and business services (72-73); motion pictures (78); health services (806-07); and engineering, accounting, research, management, and related services (87)

Company size-class--Companies are categorized by their total number of domestic employees. The following are the six company size-classes used in this report: fewer than 500 employees; 500 to

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[11] Companies primarily engaged in the manufacture of ordnance and accessories, including complete guided missiles, are grouped with companies primarily engaged in the manufacture of aircraft and parts because of the close similarity of their R&D activities.

[12] See footnote #10.

999 employees; 1,000 to 4,999 employees; 5,000 to 9,999 employees; 10,000 to 24,999 employees; and 25,000 or more employees.

Cost per R&D scientist or engineer--The number of FTE R&D scientists and engineers used to estimate the cost per R&D scientist or engineer for 1979-89 is the arithmetic mean of the numbers of FTE R&D scientists and engineers reported for January in two consecutive years. This number is then divided into the total R&D expenditures of the earlier year, and the ratio is attributed to the earlier year. For example, the mean of the numbers of FTE R&D scientists and engineers in January 1989 and January 1990 is divided into total 1989 R&D expenditures for a total cost per R&D scientist or engineer in 1989.

Method of computation--Because of rounding, detailed statistics in tables may not add to totals or subtotals. Also, percentages were calculated on the basis of thousands of dollars and may differ from those based on rounded figures shown.

Nonavailability of statistics--Census staff conduct the survey under Title 13 of the U.S. code which prohibits publication or release of data that may reveal information about individual companies. Therefore, some of the Detailed Statistical Tables, section B, contain one or both of the following footnotes:

- "(D)," which is used to indicate data are being withheld to avoid possible disclosure of information about operations of individual companies. This occurs when a small number of companies, usually one or two, accounts for a large percentage of the R&D funds or of scientists and engineers in a particular data cell. The tables most often affected by this rule are those that contain data on Federal support to companies for R&D performance; and
- "(S)," which is used to indicate that the imputation rate--the percentage of the statistic not reported by respondents and consequently estimated by Census staff--exceeds 50 percent for that item. Users should consult table A-2 for imputation rates for specific items.

Although publication of data may be withheld from certain cells, they are always included in totals. In some instances, data withheld because of high imputation rates [footnote reference "(S)"] can be derived by subtraction from higher-level totals. In such cases, the user should be aware that the derived numbers are statistically unreliable. In no instance can data be derived that would disclose operations of individual companies [footnote "(D)"].

SECTION B. DETAILED STATISTICAL TABLES

Data on all tables are reported in terms of current dollars. For the convenience of the researcher, constant dollars are also presented in one summary trend table, table B-1.

Because of rounding, details may not add to totals.

Percentages were calculated on the basis of thousands of dollars and may differ from those based on the rounded figures shown.

The publication or release of data that may reveal information about individual companies is prohibited by law. Therefore, on some tables, the symbol "(D)" is used to indicate that data are being withheld to avoid possible disclosure of information of individual companies. This occurs when a small number of companies accounts for a large percentage of the data in a particular cell.

Footnote reference "(S)" is used to indicate that the imputation rate--the percentage of the statistic estimated by Census staff--exceeds 50 percent. Interested users should consult table A-2 for imputation rates for specific items.

Although publication of data may be withheld from certain cells, the data are always included in totals. In some instances, data withheld because of high imputation rates [footnote "(S)"] can be derived by subtraction from higher-level totals. In such cases, the user should be aware that the derived numbers are statistically unreliable. In no instance can data be derived that would disclose operations of individual companies [footnote "(D)"].

To obtain accurate historical data, use only the latest detailed statistical tables and not data published earlier. Data in trend tables are assembled from the most recently completed survey cycle. Data for prior years are reviewed for consistency with current-year responses and revised when necessary. For that reason, references to prior-year data should be restricted to those published in this document.

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[Dollars in millions]

Year	Total R&D		Federal		Company (1)	
	Current dollars	Constant 1982 dollars	Current dollars	Constant 1982 dollars	Current dollars	Constant 1982 dollars
1953	$3,630	$14,021	$1,430	$5,523	$2,200	$8,497
1954	4,070	15,475	1,750	6,654	2,320	8,821
1955	4,640	17,090	2,180	8,029	2,460	9,061
1956	6,605	23,530	3,328	11,856	3,277	11,674
1957	7,731	26,585	4,335	14,907	3,396	11,678
1958	8,389	28,274	4,759	16,040	3,630	12,235
1959	9,618	31,597	5,635	18,512	3,983	13,085
1960	10,509	33,955	6,081	19,648	4,428	14,307
1961	10,908	34,917	6,240	19,974	4,668	14,942
1962	11,464	35,892	6,434	20,144	5,029	15,745
1963	12,630	38,981	7,270	22,438	5,360	16,543
1964	13,512	41,032	7,720	23,444	5,792	17,589
1965	14,185	41,992	7,740	22,913	6,445	19,079
1966	15,548	44,474	8,332	23,833	7,216	20,641
1967	16,385	45,590	8,365	23,275	8,020	22,315
1968	17,429	46,194	8,560	22,688	8,869	23,506
1969	18,308	46,023	8,451	21,244	9,857	24,779
1970	18,067	42,986	7,779	18,508	10,288	24,478
1971	18,320	41,280	7,666	17,274	10,654	24,006
1972	19,552	42,056	8,017	17,245	11,535	24,812
1973	21,249	42,893	8,145	16,441	13,104	26,451
1974	22,887	42,415	8,220	15,234	14,667	27,181
1975	24,187	40,781	8,605	14,509	15,582	26,272
1976	26,997	42,805	9,561	15,159	17,436	27,645
1977	29,825	44,330	10,485	15,584	19,340	28,746
1978	33,304	46,115	11,189	15,493	22,115	30,622
1979	38,226	48,652	12,518	15,932	25,708	32,720
1980	44,505	51,919	14,029	16,366	30,476	35,553
1981	51,810	55,140	16,382	17,435	35,428	37,705
1982	58,650	58,650	18,545	18,545	40,105	40,105
1983	65,268	62,842	20,680	19,911	44,588	42,931
1984	74,800	69,433	23,396	21,717	51,404	47,716
1985	84,239	75,925	27,196	24,512	57,043	51,413
1986	87,823	77,160	27,891	24,504	59,932	52,655
1987	92,155	78,477	30,752	26,188	61,403	52,289
1988	97,889	80,680	32,306	26,627	65,583	54,053
1989	101,599	80,436	31,366	24,833	70,233	55,604
1990 (NSF est.)	104,800	79,629	31,800	24,162	73,000	55,467
1991 (NSF est.)	109,150	79,434	33,000	24,016	76,150	55,418

(1) Company funds include funds for industrial R&D work performed within company facilities from all sources except the Federal Government. The sources of funds may comprise those from outside organizations such as research institutions, universities and colleges, other nonprofit organizations, other companies, and state governments, as well as companies' own. Company-financed R&D not performed within the company is excluded.

NOTE: The 1982 GNP implicit price deflator was used to convert current dollars to constant dollars.

SOURCE: National Science Foundation, SRS

Table B-2. Selected data for R&D-performing companies, by industry: 1988-89

Industry (1)	SIC code	Research and development funds [Dollars in millions]						Domestic net sales		R&D scientists & engineers [in thousands]		Domestic employment	
		Total		Federal		Company				January		March	
		1988	1989	1988	1989	1988	1989	1988	1989	1989	1990	1988	1989
Total		$97,889	$101,599	$32,306	$31,366	$65,583	$70,233	$2,408,892	$2,511,775	720.2	731.7	17,241	16,939
Food and kindred products	20	849	(D)	(D)	(D)	(D)	813	210,844	203,746	(D)	(S)	1,134	1,033
Tobacco manufactures	21	(D)	471	0	0	(D)	471	33,033	54,457	(D)	1.9	155	237
Textile mill products	22	165	162	0	0	165	(S)	(S)	(S)	(S)	(S)	(S)	(S)
Apparel	23	(D)	(D)	(D)	(D)	45	(S)	(S)	(S)	0.7	0.7	(S)	(S)
Lumber and wood products, except furniture	24	46	42	0	0	46	42	9,389	10,208	(S)	(S)	(S)	(S)
Furniture and fixtures	25	(D)	128	(D)	0	111	128	13,970	14,903	0.9	(S)	178	179
Paper and allied products	26	(D)	683	(D)	0	664	683	89,459	95,354	5.7	6.7	563	542
Printing, publishing, and allied industries	27	(D)	(D)	(D)	(D)	171	182	24,572	26,519	(D)	(D)	231	229
Chemicals and allied products	28	10,773	11,537	199	87	10,574	11,450	199,888	214,405	77.6	78.4	1,088	1,084
Petroleum refining and extraction	13,29	1,944	2,065	21	(S)	1,923	2,050	198,264	214,660	10.3	10.2	410	406
Rubber products	30	(D)	(D)	(D)	(D)	635	679	39,311	40,447	(S)	(S)	(S)	446
Leather and leather products	31	8	9	0	0	8	(S)	(S)	(S)	(D)	(D)	(S)	(S)
Stone, clay, and glass products	32	(D)	(D)	(D)	(D)	826	861	3,786	38,002	8.5	8.7	320	304
Primary metals	33	663	768	21	34	642	734	80,023	84,198	5.7	(S)	439	447
Fabricated metal products	34	829	788	142	136	687	652	65,544	60,745	9.7	9.4	591	515
Machinery	35	(D)	(D)	(D)	(D)	11,992	13,216	167,239	168,984	99.8	110.5	1,456	1,390
Electrical equipment	36	16,241	16,768	5,369	5,222	10,872	11,546	207,757	217,146	140.6	138.2	1,953	1,927
Transportation	37	36,338	36,863	22,176	21,763	14,162	15,100	406,673	408,687	193.0	187.8	2,623	2,566
Professional and scientific instruments	38	5,426	5,763	121	125	5,305	5,638	72,321	78,212	(S)	(S)	638	623
Miscellaneous manufacturing industries	39	(D)	(D)	(D)	(D)	203	211	9,020	9,692	3.6	3.7	84	89
Communication services	48,part 737	(D)	(D)	(D)	(D)	966	881	67,670	70,747	8.4	11.4	487	488
Electric, gas, and sanitary services	49	236	251	52	21	184	230	158,696	166,581	1.4	1.5	572	570
Computer programming, data processing, other computer-related, engineering, architectural, and surveying services	part 737,871	3,828	4,009	1,326	1,339	2,502	2,670	32,522	35,[illegible]7	(S)	(S)	268	275
Hospitals; medical and dental laboratories	806-07	151	163	3	3	148	160	7,099	4,853	(S)	(S)	982	982
Research, development, and testing services	873	1,164	1,200	549	574	615	626	12,056	12,427	8.2	7.7	194	192
Other nonmanufacturing industries	10-11,14-17,40-42,44-47,50-51,53-54,56,60,62-63,72-73,78,872,874	(D)	(D)	(D)	(D)	945	990	208,913	220,678	47.1	51.0	1,695	1,688

(1) Industries, industry groups, and product fields shown separately are classified according to Standard Industrial Classification (SIC) manual codes.
(D) Data have been withheld to avoid disclosing operations of individual companies.
(S) Data have been withheld due to imputation of more than 50 percent.

SOURCE: National Science Foundation, SRS

Table B-3. Total (company, Federal, and other) funds for industrial R&D performance, by industry and size of company: 1979-89

[Dollars in millions]

Industry and size of company	SIC code	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Total....................................	....	$38,226	$44,505	$51,810	$58,650	$65,268	$74,800	$84,239	$87,823	$92,155	$97,889	$101,599
Distribution by industry												
Food, kindred, and tobacco products (1)...............	20,21	528	620	(D)	(D)	(D)	(D)	(D)	(D)	1,206	(D)	(D)
Textiles and apparel..................................	22,23	101	115	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
Lumber, wood products, and furniture..................	24,25	139	148	161	159	152	143	147	144	137	(D)	170
Paper and allied products.............................	26	445	495	(D)	566	(D)	(D)	(D)	(D)	(D)	(D)	683
Chemicals and allied products.........................	28	4,038	4,636	5,625	6,604	7,185	7,927	8,540	8,843	9,635	10,772	11,537
Industrial chemicals................................	281-82,286	1,962	2,197	2,802	3,206	3,214	3,240	3,498	3,552	3,716	3,959	4,056
Drugs and medicines.................................	283	1,517	1,777	(D)	(D)	(D)	(D)	(D)	3,658	(D)	4,746	(D)
Other chemicals.....................................	284-85,287-89	559	662	(D)	(D)	(D)	(D)	(D)	1,633	(D)	2,067	(D)
Petroleum refining and extraction.....................	13,29	1,262	1,552	(D)	(D)	(D)	(D)	(D)	(D)	1,897	1,944	2,066
Rubber products.......................................	30	577	656	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
Stone, clay, and glass products.......................	32	356	406	(D)	(D)	(D)	(D)	(D)	950	995	(D)	(D)
Primary metals..	33	634	728	878	987	1,085	(D)	(D)	(D)	730	663	768
Ferrous metals and products.........................	331-32,3398-99	375	443	(D)	(D)	(D)	(D)	(D)	(D)	(D)	258	(D)
Nonferrous metals and products......................	333-36	259	285	(D)	(D)	(D)	336	416	458	(D)	405	(D)
Fabricated metal products.............................	34	455	550	624	625	701	842	829	895	783	829	788
Machinery...	35	4,825	5,901	6,818	8,078	9,027	10,504	12,216	(D)	(D)	(D)	(D)
Office, computing, and accounting machines..........	357	3,214	3,962	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
Other machinery, except electrical..................	351-56,358-59	1,611	1,939	(D)	(D)	(D)	(D)	(D)	2,396	2,428	2,719	2,789
Electrical equipment..................................	36	7,824	9,175	10,329	10,923	12,681	13,778	14,432	14,980	15,848	16,242	16,768
Radio and TV receiving equipment....................	365	245	556	(D)	(D)	(D)	(D)	(D)	133	139	139	85
Communication equipment.............................	366	3,635	4,024	4,758	5,839	7,298	8,685	9,397	9,669	10,184	10,296	10,508
Electronic components...............................	367	1,169	1,547	1,573	1,740	2,169	2,831	3,385	(D)	4,286	4,607	4,884
Other electrical equipment..........................	361-64,369	2,775	3,048	(D)	(D)	(D)	(D)	(D)	(D)	1,239	1,200	1,291
Transportation equipment..............................	37	12,709	14,315	(D)	(D)	(D)	(D)	(D)	31,275	34,246	36,338	36,863
Motor vehicles and motor vehicles equipment.........	371	4,509	4,955	4,806	4,797	5,318	6,057	6,984	(D)	(D)	(D)	(D)
Other transportation equipment......................	373-75,379	159	162	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
Aircraft and missiles...............................	372,376	8,041	9,198	11,968	14,451	15,406	18,858	22,231	21,050	24,458	25,900	25,654

See footnotes at end of

Table B-3. Total (company, Federal, and other) funds for industrial R&D performance, by industry and size of company: 1979-89 (continued)

[Dollars in millions]

Industry and size of company	SIC code	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Distribution by industry												
Professional and scientific instruments	38	$2,505	$3,029	$3,614	$3,930	$4,266	$4,602	$5,013	$5,103	$5,222	$5,426	$5,763
Scientific and mechanical measuring instruments	381-82	950	1,352	(D)	(D)	(D)	(D)	(D)	(D)	(D)	1,734	1,868
Optical, surgical, photographic, and other instruments	383-87	1,555	1,677	(D)	(D)	(D)	(D)	(D)	(D)	(D)	3,692	3,895
Other manufacturing industries (1)	27,31,39	288	364	(D)	(D)	(D)	(D)	(D)	382	(D)	(D)	(D)
Nonmanufacturing industries	10-11,14-17,40-42,44-51,53-54,56,60,62-63,72-73,78,806-07,87	1,540	1,815	1,906	2,472	3,337	4,905	6,714	7,446	7,844	8,113	8,273
Distribution by size of company [Based on number of employees]												
Less than 500		1,764	2,065	2,305	2,934	4,422	4,402	5,866	7,071	7,163	(S)	7,446
500 to 999							1,439	1,648	1,902	1,725	1,656	1,718
1,000 to 4,999		2,483	2,701	3,148	3,864	4,178	5,520	6,240	7,472	7,262	7,598	7,843
5,000 to 9,999		1,691	2,028	2,988	2,751	2,798	3,251	4,022	4,251	4,501	5,236	5,475
10,000 to 24,999		5,191	6,017	6,762	7,943	9,499	11,351	11,109	10,493	12,043	11,473	10,432
25,000 or more		27,097	31,693	36,607	41,156	44,372	48,837	55,354	56,991	59,461	64,678	68,685

(D) Data have been withheld to avoid disclosing operations of individual companies.
(S) Data have been withheld due to imputation of more than 50 percent.
(1) Until 1984, tobacco products (SIC 21) was included with "other manufacturing industries."

SOURCE: National Science Foundation, SRS

Table B-4. Total (company, Federal, and other) funds for industrial R&D performance, by industry, by size of company: 1989

[Dollars in millions]

Industry	SIC code	Total funds	Size of company: Less than 500 employees	500 to 999 employees	1,000 to 4,999 employees	5,000 to 9,999 employees	10,000 to 24,999 employees	25,000 or more employees
Total		$101,599	$7,446	$1,718	$7,843	$5,475	$10,432	$68,685
Food, kindred, and tobacco products	20,21	(D)	(S)	3	134	(D)	195	791
Textiles and apparel	22,23	(D)	(D)	(S)	39	(S)	83	40
Lumber, wood products, and furniture	24,25	170	(D)	(S)	59	15	57	(D)
Paper and allied products	26	683	(S)	16	90	56	280	160
Chemicals and allied products	28	11,537	(D)	(D)	(D)	(D)	(D)	4,561
Industrial chemicals	281-82,286	4,056	(S)	(D)	(D)	(D)	(D)	(D)
Drugs and medicines	283	(D)	(D)	(D)	(D)	(D)	(D)	(D)
Other chemicals	284-85,287-89	(D)	520	(D)	(D)	(D)	691	(D)
Petroleum refining and extraction	13,29	2,066	11	(D)	(D)	(D)	(D)	(D)
Rubber products	30	(D)	(D)	(S)	(D)	(D)	143	(D)
Stone, clay, and glass products	32	(D)	(D)	(S)	45	45	318	(D)
Primary metals	33	768	(D)	(D)	(D)	(D)	(D)	(D)
Ferrous metals and products	331-32,3398-99	(D)	(S)	(D)	(D)	(D)	54	(D)
Nonferrous metals and products	333-36	(D)	(D)	(S)	(D)	(D)	(D)	(D)
Fabricated metal products	34	788	(D)	(S)	(D)	(D)	337	0
Machinery	35	(D)	1,118	405	1,145	(D)	(D)	(D)
Office, computing, and accounting machines	357	(D)	564	210	(D)	(D)	(D)	(D)
Other machinery, except electrical	351-56,358-59	2,789	(S)	195	(D)	(D)	(D)	(D)
Electrical equipment	36	16,768	1,571	297	1,280	682	1,560	11,379
Radio and TV receiving equipment	365	85	(S)	(D)	(S)	(D)	0	0
Communication equipment	366	10,508	(D)	88	389	(D)	495	8,954
Electronic components	367	4,884	887	(D)	(D)	(D)	(D)	(D)
Other electrical equipment	361-64,369	1,291	(D)	74	(D)	159	(D)	(D)
Transportation equipment	37	36,863	(S)	54	(D)	179	1,386	(D)
Motor vehicles and motor vehicles equipment	371	(D)	(D)	(D)	(D)	(D)	(D)	(D)
Other transportation equipment	373-75,379	(D)	(S)	6	24	0	(D)	0
Aircraft and missiles	372,376	25,654	(D)	(D)	(D)	(D)	(D)	24,487

See footnotes at end of

Table B-4. Total (company, Federal, and other) funds for industrial R&D performance, by industry, by size of company: 1989 (continued)

[Dollars in millions]

Industry	SIC code	Total funds	Less than 500 employees	500 to 999 employees	1,000 to 4,999 employees	5,000 to 9,999 employees	10,000 to 24,999 employees	25,000 or more employees
			Size of company					
Professional and scientific instruments...........	38	$5,763	(S)	(D)	(D)	(D)	(D)	(D)
Scientific and mechanical measuring instruments.	381-82	1,868	(D)	71	206	(D)	(D)	(D)
Optical, surgical, photographic, and other instruments.....................................	383-87	3,895	(D)	(D)	(D)	(D)	(D)	(D)
Other manufacturing industries....................	27,31,39	(D)	(S)	(D)	(D)	75	133	0
Nonmanufacturing industries.......................	10-11,14-17,40-42,44-51,53-54,56,60,62-63,72-73,78,806-07,87	8,273	3,162	490	1,938	(D)	(D)	(D)

(D) Data have been withheld to avoid disclosing operations of individual companies.
(S) Data have been withheld due to imputation of more than 50 percent.

SOURCE: National Science Foundation, SRS

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Table B-5. Total (company, Federal, and other) funds for industrial R&D performance, by industry and size of company, by size of R&D program: 1989

Industry and size of company	SIC code	Total	Size of R&D program [Dollars in thousands]				
			Less than $200	$200 to $999	$1,000 to $9,999	$10,000 to $99,999	$100,000 or more
			[Dollars in millions]				
Total		$101,599	(S)	(S)	$6,492	$12,684	$78,955
Distribution by industry							
Food, kindred, and tobacco products	20,21	(D)	(S)	(S)	136	729	(D)
Textiles and apparel	22,23	(D)	(D)	(S)	72	97	0
Lumber, wood products, and furniture	24,25	170	(S)	(S)	65	89	0
Paper and allied products	26	683	(D)	(S)	72	423	(D)
Chemicals and allied products	28	11,537	(S)	(S)	587	1,662	8,978
Industrial chemicals	281-82,286	4,056	(D)	(D)	101	810	3,119
Drugs and medicines	283	(D)	(S)	(D)	48	322	4,774
Other chemicals	284-85,287-89	(D)	(D)	(S)	438	530	1,085
Petroleum refining and extraction	13,29	2,066	(S)	(S)	42	238	1,778
Rubber products	30	(D)	(S)	(S)	87	322	(D)
Stone, clay, and glass products	32	(D)	(S)	(S)	49	244	(D)
Primary metals	33	768	(D)	(S)	130	426	(D)
Ferrous metals and products	331-32,3398-99	(D)	(D)	(S)	60	193	0
Nonferrous metals and products	333-36	(D)	(S)	(S)	70	233	(D)
Fabricated metal products	34	788	(D)	(S)	196	354	(D)
Machinery	35	(D)	(S)	(S)	1,204	1,823	(D)
Office, computing, and accounting machines	357	(D)	(S)	5	632	827	(D)
Other machinery, except electrical	351-56,358-59	2,789	(S)	(S)	572	995	873
Electrical equipment	36	16,768	(S)	(S)	1,483	2,033	12,731
Radio and TV receiving equipment	365	85	(D)	(S)	13	(D)	0
Communication equipment	366	10,508	(S)	(S)	362	533	9,482
Electronic components	367	4,884	(D)	(S)	758	891	(D)
Other electrical equipment	361-64,369	1,291	(D)	(S)	350	(D)	(D)
Transportation equipment	37	36,863	(S)	(S)	117	782	35,902
Motor vehicles and motor vehicles equipment	371	(D)	(S)	(S)	60	266	(D)
Other transportation equipment	373-75,379	(D)	(D)	(S)	36	191	(D)
Aircraft and missiles	372,376	25,654	(D)	(S)	20	324	25,305

See footnotes at end of

Table B-5. Total (company, Federal, and other) funds for industrial R&D performance, by industry and size of company, by size of R&D program: 1989 (continued)

Industry and size of company	SIC code	Total	Size of R&D program [Dollars in thousands]				
			Less than $200	$200 to $999	$1,000 to $9,999	$10,000 to $99,999	$100,000 or more
Distribution by industry			[Dollars in millions]				
Professional and scientific instruments	38	5,763	(S)	(S)	484	708	4,256
Scientific and mechanical measuring instruments	381-82	1,868	(D)	(S)	292	246	(D)
Optical, surgical, photographic, and other instruments	383-87	3,895	(D)	(S)	192	462	(D)
Other manufacturing industries	27,31,39	(D)	(D)	(S)	102	270	0
Nonmanufacturing industries	10-11,14-17,40-42,44-51,53-54,56,60,62-63,72-73,78,806-07,87	8,273	(S)	(S)	1,667	2,484	2,665
Distribution by size of company [Based on number of employees]							
Less than 500		7,446	(S)	(S)	3,720	584	0
500 to 999		1,718	(S)	(S)	730	831	0
1,000 to 4,999		7,843	(S)	(S)	1,550	4,929	1,220
5,000 to 9,999		6,545	(S)	(S)	301	2,272	3,957
10,000 to 24,999		10,432	(D)	(D)	165	2,962	7,298
25,000 or more		67,615	(D)	(D)	26	1,107	66,480

(S) Data have been withheld due to imputation of more than 50 percent.
(D) Data have been withheld to avoid disclosing operations of individual companies.

SOURCE: National Science Foundation, SRS

Table B-6. Number of R&D-performing companies, by industry and size of company, by size of R&D program: 1989

Industry and size of company	SIC code	Total	Size of R&D program [Dollars in thousands] Less than $200	$200 to $999	$1,000 to $9,999	$10,000 to $99,999	$100,000 or more
Total		24,775	16,625	5,513	2,078	438	121
Food, kindred, and tobacco products	20,21	133	39	35	33	24	2
Textiles and apparel	22,23	457	310	120	22	5	0
Lumber, wood products, and furniture	24,25	154	100	26	24	4	0
Paper and allied products	26	326	122	167	22	14	1
Chemicals and allied products	28	2,471	1,810	413	168	52	28
Industrial chemicals	281-82,286	253	104	100	21	20	8
Drugs and medicines	283	439	301	102	11	9	16
Other chemicals	284-85,287-89	1,779	1,405	211	136	23	4
Petroleum refining and extraction	13,29	134	104	6	9	7	8
Rubber products	30	488	391	60	25	11	1
Stone, clay, and glass products	32	155	89	39	17	8	2
Primary metals	33	253	166	39	30	17	1
Ferrous metals and products	331-32,3398-99	122	82	18	14	8	0
Nonferrous metals and products	333-36	131	84	21	16	9	1
Fabricated metal products	34	2,041	1,788	159	84	9	1
Machinery	35	2,801	1,761	502	448	73	17
Office, computing, and accounting machines	357	501	201	11	247	29	13
Other machinery, except electrical	351-56,358-59	2,300	1,560	491	201	44	4
Electrical equipment	36	3,687	2,165	1,020	413	68	21
Radio and TV receiving equipment	365	179	147	27	4	1	0
Communication equipment	366	665	203	346	86	18	12
Electronic components	367	1,351	688	426	200	30	7
Other electrical equipment	361-64,369	1,492	1,127	221	123	19	2
Transportation equipment	37	270	30	154	40	25	21
Motor vehicles and motor vehicles equipment	371	159	7	123	17	9	3
Other transportation equipment	373-75,379	68	21	24	19	3	1
Aircraft and missiles	372,376	43	2	7	4	13	17

See footnotes at end of

Table B-6. Number of R&D-performing companies, by industry, size of company, and size of R&D program: 1989 (continued)

Industry and size of company	SIC code	Total	Size of R&D program [Dollars in thousands]				
			Less than $200	$200 to $999	$1,000 to $9,999	$10,000 to $99,999	$100,000 or more
Professional and scientific instruments	38	1907	1186	532	155	26	8
Scientific and mechanical measuring instruments	381-82	1,018	671	242	92	11	2
Optical, surgical, photographic, and other instruments	383-87	889	515	290	63	15	6
Other manufacturing industries	27,31,39	398	327	34	27	10	0
Nonmanufacturing industries	10-11,14-17,40-42,44-51,53-54,56,60,62-63,72-73,78,806-07,87	9100	6237	2207	561	85	10
Distribution by size of company [Based on number of employees]							
Less than 500		22,486	16,202	4,905	1,348	31	0
500 to 999		761	166	329	225	41	0
1,000 to 4,999		1,043	225	237	392	180	9
5,000 to 9,999		187	12	24	66	71	14
10,000 to 24,999		175	3	14	39	86	33
25,000 or more		123	17	4	8	29	65

SOURCE: National Science Foundation, SRS

Table B-7. Company and other (except Federal) funds for industrial R&D performance, by industry and size of company: 1979-89

[Dollars in millions]

Industry and size of company	SIC code	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Total		$25,708	$30,476	$35,428	$40,105	$44,588	$51,404	$57,043	$59,932	$61,403	$65,583	$70,233
Distribution by industry												
Food, kindred, and tobacco products (1)	20,21	(D)	(D)	636	777	824	1,081	1,136	1,280	1,204	1,192	1,283
Textiles and apparel	22,23	(D)	(D)	116	136	150	182	218	246	243	210	(S)
Lumber, wood products, and furniture	24,25	139	(D)	161	159	152	143	147	144	137	156	170
Paper and allied products	26	(D)	(D)	566	566	552	594	576	538	604	664	683
Chemicals and allied products	28	3,692	4,264	5,205	6,197	6,792	7,736	8,310	8,664	9,445	10,573	11,449
Industrial chemicals	281-82,286	1,617	1,856	2,393	2,810	2,828	3,057	3,281	3,374	3,531	3,763	3,972
Drugs and medicines	283	(D)	(D)	2,064	2,473	2,896	3,310	3,481	3,657	4,095	4,743	5,206
Other chemicals	284-85,287-89	(D)	653	747	914	1,068	1,369	1,548	1,633	1,819	2,067	2,271
Petroleum refining and extraction	13,29	1,109	1,401	1,780	2,003	2,074	2,245	2,194	1,971	1,883	1,923	2,050
Rubber products	30	(D)	(D)	598	617	638	671	659	655	596	635	679
Stone, clay, and glass products	32	(D)	(D)	411	472	586	705	825	941	985	826	861
Primary metals	33	539	594	702	711	701	683	730	786	711	642	734
Ferrous metals and products	331-32,3398-99	305	338	415	426	396	357	323	336	249	257	271
Nonferrous metals and products	333-36	234	256	287	285	305	326	407	450	462	385	463
Fabricated metal products	34	414	501	545	565	634	773	780	800	633	687	653
Machinery	35	4,490	5,254	6,124	7,227	7,911	9,312	10,721	10,701	10,577	11,992	13,216
Office, computing, and accounting machines	357	2,958	(D)	3,847	4,944	5,634	7,011	8,418	8,380	8,193	9,371	10,533
Other machinery, except electrical	351-56,358-59	1,532	(D)	2,277	2,283	2,277	2,301	2,303	2,321	2,384	2,621	2,683
Electrical equipment	36	4,515	5,431	6,409	6,682	8,158	9,037	9,271	9,767	10,449	10,872	11,546
Radio and TV receiving equipment	365	192	346	358	364	324	362	350	133	139	139	85
Communication equipment	366	2,049	2,367	2,975	3,555	4,500	5,147	5,174	5,117	5,455	5,675	5,842
Electronic components	367	(D)	1,165	1,212	1,342	1,810	2,354	2,826	3,357	3,630	3,879	4,362
Other electrical equipment	361-64,369	(D)	1,553	1,864	1,421	1,524	1,174	921	1,160	1,225	1,179	1,257
Transportation equipment	37	(D)	6,958	7,739	8,621	8,991	10,406	12,092	13,567	13,462	14,162	15,100
Motor vehicles and motor vehicles equipment	371	3,780	4,300	4,219	4,321	4,754	5,384	6,164	7,171	7,167	7,769	8,726
Other transportation equipment	373-75,379	(D)	(D)	80	114	227	258	279	330	356	370	354
Aircraft and missiles	372,376	2,201	2,570	3,440	4,186	4,010	4,764	5,649	6,066	5,939	6,023	6,020

See footnotes at end of table

Table B-7. Company and other (except Federal) funds for industrial R&D performance, by industry and size of company: 1979-89 (continued)

[Dollars in millions]

Industry and size of company	SIC code	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Distribution by industry												
Professional and scientific instruments	38	$2,012	$2,456	$2,978	$3,407	$3,816	$4,211	$4,622	$4,752	$4,950	$5,306	$5,638
Scientific and mechanical measuring instruments	381-82	747	1,001	1,235	1,363	1,605	1,671	1,596	1,521	1,598	1,710	1,858
Optical, surgical, photographic, and other instruments	383-87	1,265	1,454	1,743	2,044	2,211	2,540	3,026	3,231	3,352	3,596	3,780
Other manufacturing industries (1)	27,31,39	288	339	411	493	525	373	361	380	380	383	402
Nonmanufacturing industries	10-11,14-17,40-42,44-51,53-54,56,60,62-63,72-73,78,806-07,87	859	1,037	1,048	1,472	2,084	3,252	4,401	4,740	5,144	5,360	5,557
Distribution by size of company [Based on number of employees]												
Less than 500		1,375	1,711	1,880	2,411	3,781	3,781	5,127	6,203	6,200	(S)	(S)
500 to 999							1,341	1,531	1,765	1,610	1,517	1,613
1,000 to 4,999		1,893	2,257	2,586	3,241	3,438	4,618	5,249	6,243	6,281	6,441	6,730
5,000 to 9,999		1,463	1,596	2,369	2,224	2,080	2,764	3,350	3,455	3,753	4,322	4,662
10,000 to 24,999		4,012	4,867	5,537	6,448	7,228	8,546	8,366	8,489	9,681	9,668	9,187
25,000 or more		16,965	20,045	23,056	25,781	28,061	30,354	33,421	33,778	33,878	37,249	41,535

(D) Data have been withheld to avoid disclosing operations of individual companies.
(S) Data have been withheld due to imputation of more than 50 percent.
(1) Until 1984, tobacco products (SIC 21) was included with "other manufacturing industries."

NOTE: Company funds include all funds for industrial R&D work performed within company facilities from all sources except the Federal Government. The sources of funds may comprise those from outside organizations such as research institutions, universities and colleges, other nonprofit organizations, other companies, and state governments, as well as companies' own. Company-financed R&D not performed within the company is excluded.

SOURCE: National Science Foundation, SRS

Table B-8. Company and other (except Federal) funds for industrial R&D performance, by industry, by size of company: 1989

[Dollars in millions]

Industry	SIC code	Total funds	Size of company: Less than 500 employees	500 to 999 employees	1,000 to 4,999 employees	5,000 to 9,999 employees	10,000 to 24,999 employees	25,000 or more employees
Total		$70,233	(S)	$1,613	$6,730	$4,662	$9,187	$41,535
Food, kindred, and tobacco products	20,21	1,283	(S)	(S)	134	135	195	791
Textiles and apparel	22,23	(S)	(S)	(S)	39	(S)	(S)	(S)
Lumber, wood products, and furniture	24,25	170	(D)	(S)	59	15	57	(D)
Paper and allied products	26	683	(S)	16	90	56	280	160
Chemicals and allied products	28	11,449	639	137	1,623	499	4,001	4,550
Industrial chemicals	281-82,286	3,972	(S)	49	451	416	405	2,617
Drugs and medicines	283	5,206	(S)	33	657	(D)	2,905	(D)
Other chemicals	284-85,287-89	2,271	520	55	515	(D)	691	(D)
Petroleum refining and extraction	13,29	2,050	11	(D)	54	(D)	291	1,643
Rubber products	30	679	(D)	(S)	126	132	143	(D)
Stone, clay, and glass products	32	861	(D)	(S)	45	45	316	(D)
Primary metals	33	734	(S)	(S)	196	111	150	245
Ferrous metals and products	331-32,3398-99	271	(S)	(S)	66	(D)	54	(D)
Nonferrous metals and products	333-36	463	(S)	(S)	130	(D)	96	(D)
Fabricated metal products	34	653	(S)	(S)	125	104	244	0
Machinery	35	13,216	1,116	405	1,108	1,883	717	7,987
Office, computing, and accounting machines	357	10,533	564	210	458	1,698	267	7,336
Other machinery, except electrical	351-56,358-59	2,683	(S)	195	650	185	450	651
Electrical equipment	36	11,546	1,522	249	1,109	521	1,169	6,976
Radio and TV receiving equipment	365	85	(S)	(D)	(S)	(D)	0	0
Communication equipment	366	5,842	389	88	256	62	133	4,914
Electronic components	367	4,362	860	93	521	251	858	1,779
Other electrical equipment	361-64,369	1,257	(S)	(D)	325	(D)	178	283
Transportation equipment	37	15,100	(S)	(D)	195	165	729	(D)
Motor vehicles and motor vehicles equipment	371	8,726	(D)	(D)	89	(D)	(S)	(D)
Other transportation equipment	373-75,379	354	(S)	6	24	0	309	0
Aircraft and missiles	372,376	6,020	(D)	17	81	(D)	279	5,540

See footnotes at end of

Table B-8. Company and other (except Federal) funds for industrial R&D performance, by industry, by size of company: 1989 (continued)

[Dollars in millions]

Industry	SIC code	Total funds	Size of company: Less than 500 employees	500 to 999 employees	1,000 to 4,999 employees	5,000 to 9,999 employees	10,000 to 24,999 employees	25,000 or more employees
Professional and scientific instruments..............	38	$5,638	(S)	135	$483	$364	$354	$3,745
Scientific and mechanical measuring instruments....	381-82	1,858	(S)	71	206	(D)	(D)	(D)
Optical, surgical, photographic, and other instruments..	383-87	3,780	(S)	64	277	(D)	(D)	(D)
Other manufacturing industries.......................	27,31,39	402	(S)	39	139	75	133	0
Nonmanufacturing industries..........................	10-11,14-17,40-42,44-51,53-54,56,60,62-63,72-73,78,806-07,87	5,557	(S)	460	1,204	492	324	792

(S) Data have been withheld because of imputation of more than 50 percent.
(D) Data have been withheld to avoid disclosing operations of individual companies.

SOURCE: National Science Foundation, SRS

Table B-9. Company-financed research and development contracted to outside organizations, by industry and size of company: 1989

[Dollars in millions]

Industry	SIC code	1989
Total		$2,657
Distribution by industry		
Food, kindred, and tobacco products	20,21	45
Textiles and apparel	22,23	2
Lumber, wood products, and furniture	24,25	(D)
Paper and allied products	26	17
Chemicals and allied products	28	788
Industrial chemicals	281-82,286	105
Drugs and medicines	283	499
Other chemicals	284-85,287-89	184
Petroleum refining and extraction	13,29	57
Rubber products	30	17
Stone, clay, and glass products	32	(D)
Primary metals	33	14
Ferrous metals and products	331-32,3398-99	(D)
Nonferrous metals and products	333-36	(D)
Fabricated metal products	34	2
Machinery	35	158
Office, computing, and accounting machines	357	138
Other machinery, except electrical	351-56,358-59	20
Electrical equipment	36	131
Radio and TV receiving equipment	365	0
Communication equipment	366	84
Electronic components	367	28
Other electrical equipment	361-64,369	19
Transportation equipment	37	742
Motor vehicles and motor vehicles equipment	371	(D)
Other transportation equipment	373-75,379	(S)
Aircraft and missiles	372,376	(D)
Professional and scientific instruments	38	(D)
Scientific and mechanical measuring instruments	381-82	3
Optical, surgical, photographic, and other instruments	383-87	(D)
Other manufacturing industries	27,31,39	1
Nonmanufacturing industries	10-11,14-17,40-42,44-51,53-54,56,60,62-63,72-73,78,806-07,87	433
Distribution by size of company [Based on number of employees]		
Less than 500		(S)
500 to 999		32
1,000 TO 4,999		288
5,000 TO 9,999		120
10,000 TO 24,999		683
25,000 or more		1,414

(D) Data have been withheld to avoid disclosing operations of individual companies.
(S) Data have been withheld due to imputation of 50 percent or more.

SOURCE: National Science Foundation, SRS

Table B-10. Number of companies contracting research and development to outside organizations, by industry, by size of company: 1989

Industry	SIC code	Less than 500 employees		500 to 999 employees		1,000 to 4,999 employees		5,000 to 9,999 employees		10,000 to 24,999 employees		25,000 or more employees	
		Size of company											
		Total	Outside	Total	Outside	Total	Outside	Total	Outside	Total	Outside	Total	Outside
Total	....	22,486	337	761	57	1,043	136	187	46	175	58	123	46
Food, kindred, and tobacco products	20,21	8	0	35	2	48	7	14	3	13	4	15	5
Textiles and apparel	22,23	286	1	106	1	44	1	8	0	9	1	4	1
Lumber, wood products, and furniture	24,25	78	1	27	0	37	3	7	0	4	3	1	0
Paper and allied products	26	261	0	13	1	32	3	9	1	8	2	3	2
Chemicals and allied products	28	2,325	7	39	13	68	29	9	5	21	11	9	2
Industrial chemicals	281-82,286	204	0	11	5	23	10	6	3	4	1	5	1
Drugs and medicines	283	407	4	6	2	12	7	1	1	10	8	3	0
Other chemicals	284-85,287-89	1,714	3	22	6	33	12	2	1	7	2	1	1
Petroleum refining and extraction	13,29	104	0	3	0	11	1	5	0	4	3	7	5
Rubber products	30	308	0	35	0	133	7	5	2	6	1	1	1
Stone, clay, and glass products	32	86	0	26	0	29	2	6	1	6	3	2	1
Primary metals	33	169	0	23	0	41	7	10	4	7	2	3	0
Ferrous metals and products	331-32,3398-99	79	0	10	0	20	4	7	2	3	1	2	0
Nonferrous metals and products	333-36	89	0	13	0	21	3	3	2	4	1	1	0
Fabricated metal products	34	1,907	0	57	1	60	5	10	2	7	2	0	0
Machinery	35	2,535	7	98	12	124	17	26	5	11	2	7	5
Office, computing, and accounting machines	357	431	4	24	3	28	4	11	2	3	2	4	3
Other machinery, except electrical	351-56,358-59	2,104	3	74	9	96	13	15	3	8	0	3	2
Electrical equipment	36	3,424	72	104	10	114	17	15	3	15	3	15	4
Radio and TV receiving equipment	365	172	0	3	0	3	0	1	0	0	0	0	0
Communication equipment	366	613	55	15	3	20	1	4	0	4	1	9	3
Electronic components	367	1,267	12	35	5	38	5	4	2	5	1	2	1
Other electrical equipment	361-64,369	1,372	5	51	2	53	11	6	1	6	1	4	0
Transportation equipment	37	150	0	32	3	45	7	9	3	16	5	18	12
Motor vehicles and motor vehicles equipment	371	100	0	19	2	25	3	5	2	6	1	4	4
Other transportation equipment	373-75,379	49	0	6	0	9	3	0	0	4	2	0	0
Aircraft and missiles	372,376	1	0	7	1	11	1	4	1	6	2	14	8

See footnotes at end of

Table B-10. Number of companies contracting research and development to outside organizations, by industry, by size of company: 1989 (continued)

Industry	SIC code	Size of company											
		Less than 500 employees		500 to 999 employees		1,000 to 4,999 employees		5,000 to 9,999 employees		10,000 to 24,999 employees		25,000 or more employees	
		Total	Outside	Total	Outside	Total	Outside	Total	Outside	Total	Outside	Total	Outside
Professional and scientific instruments...........	38	1,808	43	38	6	44	7	10	2	3	1	4	1
Scientific and mechanical measuring instruments.	381-82	979	40	15	2	18	0	5	0	1	0	0	0
Optical, surgical, photographic, and other instruments....................................	383-87	829	3	23	4	26	7	5	2	2	1	4	1
Other manufacturing industries....................	27,31,39	310	1	36	2	38	2	7	1	7	0	0	0
Nonmanufacturing industries........................	10-11,14-17,40-42,44-51,53-54,56,60,62-63,72-73,78,806-07,87	8,727	205	89	6	175	21	37	14	38	15	34	7

SOURCE: National Science Foundation, SRS

Table B-11. Company-financed research and development performed outside the United States by U.S. domestic companies and their foreign subsidiaries, by selected industry: 1979-89

[Dollars in millions]

Industry	SIC code	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Total		$2,754	$3,165	$3,393	$3,094	$3,269	$3,633	$3,650	$4,624	$5,226	$6,295	$6,519
Food, kindred, and tobacco products (1)	20,21	51	54	62	64	63	70	75	69	37	27	34
Chemicals and allied products	28	500	603	715	682	729	786	843	1,071	1,243	1,501	1,287
Industrial and other chemicals	281-82,284-89	199	246	287	319	368	385	444	579	625	781	473
Drugs and medicines	283	301	357	428	363	361	401	399	492	618	720	814
Petroleum refining and extraction	13,29	(2)	141	194	133	103	101	47	40	47	58	46
Stone, clay, and glass products	32	(3)	21	18	10	19	60	(D)	(D)	(D)	(D)	(D)
Primary metals	33	11	11	9	9	10	9	(D)	(D)	18	24	23
Fabricated metal products	34	(3)	(3)	30	25	23	21	21	26	40	(D)	(D)
Machinery	35	534	599	612	494	577	740	689	951	1,233	1,364	1,455
Electrical equipment	36	445	451	475	467	482	537	591	(S)	432	669	615
Radio and TV receiving equipment	365	(3)	(3)	(3)	(3)	(3)	(D)	(D)	(D)	0	(D)	(D)
Communication equipment	366						(D)	(D)	(D)	188	339	278
Electronic components	367	25	29	40	38	(3)	92	117	150	204	278	245
Other electrical equipment	361-64,369	11	11	39	43	38	30	24	25	39	(D)	(D)
Transportation equipment	37	874	1,020	884	843	880	907	1,025	(D)	(D)	1,801	2,101
Motor vehicles and other transportation equipment	371,373-75,379	(3)	(3)	(3)	(3)	(3)	(D)	(D)	(D)	(D)	1,469	1,491
Aircraft and missiles	372,376	(3)	(3)	(3)	(3)	(3)	(D)	(D)	182	237	332	610
Professional and scientific instruments	38	156	186	230	237	(3)	263	169	212	317	393	441
Other manufacturing industries (1)	22-27,30-31,39	213	139	156	123	92	131	125	141	138	145	166
Nonmanufacturing industries	10-11,14-17,40-42,44-51,53-54,56,60,62-63,72-73,78,806-07,87	5	7	8	7	10	8	18	27	64	95	89

(D) Data have been withheld to avoid disclosing operations of individual companies.
(S) Data have been withheld due to imputation of more than 50 percent.
(1) Until 1984, tobacco products, SIC 21, was included with "other manufacturing industries."
(2) Included in the other manufacturing industries group.
(3) Not separately available but included in total.

NOTE: Data are reported in current U.S. dollars.

SOURCE: National Science Foundation, SRS

Table B-12. Federal funds for industrial R&D performance, by industry and size of company: 1979-89

[Dollars in millions]

Industry and size of company	SIC code	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Total		$12,518	$14,029	$16,382	$18,545	$20,680	$23,396	$27,19[illegible]	$27,891	$30,752	$32,306	$31,366
Distribution by industry												
Food, kindred, and tobacco products (1)	20,21	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	2	(D)	(D)
Textiles and apparel	22,23	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
Lumber, wood products, and furniture	24,25	0	(D)	0	0	0	0	0	0	0	(D)	0
Paper and allied products	26	(D)	(D)	(D)	0	(D)	(D)	(D)	(D)	(D)	(D)	0
Chemicals and allied products	28	346	372	421	407	393	191	230	179	190	199	88
Industrial chemicals	281-82,286	345	341	409	396	386	183	217	178	185	196	84
Drugs and medicines	283	(D)	(D)	(D)	(D)	(D)	(D)	(D)	1	(D)	3	(D)
Other chemicals	284-85,287-89	(D)	(D)	(D)	(D)	(D)	(D)	(D)	0	(D)	0	(D)
Petroleum refining and extraction	13,29	153	151	(D)	(D)	(D)	(D)	(D)	(D)	14	21	(S)
Rubber products	30	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
Stone, clay, and glass products	32	(D)	(D)	(D)	(D)	(D)	(D)	(D)	9	10	(D)	(D)
Primary metals	33	95	135	176	276	384	(D)	(D)	(D)	19	21	34
Ferrous metals and products	331-32,3398-99	70	105	(D)	(D)	(D)	(D)	(D)	(D)	(D)	1	(D)
Nonferrous metals and products	333-36	25	30	(D)	(D)	(D)	10	9	8	(D)	20	(D)
Fabricated metal products	34	41	49	80	60	67	69	49	95	150	142	135
Machinery	35	335	647	694	851	1,116	1,192	1,495	(D)	(D)	(D)	(D)
Office, computing, and accounting machines	357	256	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
Other machinery, except electrical	351-56,358-59	79	(D)	(D)	(D)	(D)	(D)	(D)	75	44	98	106
Electrical equipment	36	3,309	3,744	3,920	4,241	4,523	4,741	5,161	5,213	5,399	5,370	5,222
Radio and TV receiving equipment	365	53	210	(D)	(D)	(D)	(D)	(D)	0	0	0	0
Communication equipment	366	1,586	1,657	1,783	2,284	2,798	3,538	4,223	4,552	4,729	4,621	4,666
Electronic components	367	(D)	382	361	398	359	477	559	(D)	656	728	522
Other electrical equipment	361-64,369	(D)	1,495	(D)	(D)	(D)	(D)	(D)	(D)	14	21	34
Transportation equipment	37	(D)	(D)	(D)	(D)	(D)	(D)	(D)	17,708	20,784	22,176	21,763
Motor vehicles and motor vehicles equipment	371	729	655	587	476	564	673	820	(D)	(D)	(D)	(D)
Other transportation equipment	373-75,379	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
Aircraft and missiles	372,376	5,840	6,628	8,528	10,265	11,396	14,094	16,582	14,984	18,519	19,877	19,634

See footnotes at end of

Table B-12. Federal funds for industrial R&D performance, by industry and size of company: 1979-89 (continued)

[Dollars in millions]

Industry and size of company	SIC code	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Distribution by industry												
Professional and scientific instruments.............	38	$493	$573	$637	$523	$450	$391	$391	$351	$272	$120	$125
Scientific and mechanical measuring instruments...	381-82	203	350	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(S)	(S)
Optical, surgical, photographic, and other instruments.......................................	383-87	290	223	(D)	(D)	(D)	(D)	(D)	(D)	(D)	96	115
Other manufacturing industries (1)..................	27,31,39	0	25	(D)	(D)	(D)	(D)	(D)	2	(D)	(D)	(D)
Nonmanufacturing industries..........................	10-11,14-17,40-42,44-51,53-54,56,60,62-63,72-73,78,806-07,87	681	779	858	1,000	1,253	1,653	2,313	2,706	2,700	2,753	2,716
Distribution by size of company [Based on number of employees]												
Less than 500...	....	389	354	424	523	641	621	739	868	963	864	940
500 to 999..	....						98	117	137	115	139	105
1,000 to 4,999..	....	590	444	562	623	740	902	991	1,229	981	1,157	1,113
5,000 to 9,999..	....	228	432	619	527	718	487	672	796	748	914	813
10,000 to 24,999......................................	....	1,179	1,150	1,225	1,495	2,271	2,805	2,743	2,004	2,362	1,805	1,245
25,000 or more..	....	10,132	11,648	13,551	15,377	16,311	18,483	21,933	23,213	25,583	27,428	27,150

(D) Data have been withheld to avoid disclosing operations of individual companies.
(S) Data have been withheld due to imputation of more than 50 percent.
(1) Until 1984, tobacco products, SIC 21, was included with "other manufacturing industries."

SOURCE: National Science Foundation, SRS

Table B-13. Federal funds for industrial R&D performance, by industry, by size of company: 1989

[Dollars in millions]

Industry	SIC code	Total funds	Size of company					
			Less than 500 employees	500 to 999 employees	1,000 to 4,999 employees	5,000 to 9,999 employees	10,000 to 24,999 employees	25,000 or more employees
Total..	....	$31,366	$940	$105	$1,113	$813	$1,245	$27,150
Food, kindred, and tobacco products..................	20,21	(D)	0	0	0	(D)	0	0
Textiles and apparel................................	22,23	(D)	(D)	0	0	0	0	0
Lumber, wood products, and furniture................	24,25	0	0	0	0	0	0	0
Paper and allied products...........................	26	0	0	0	0	0	0	0
Chemicals and allied products.......................	28	88	(D)	(D)	(D)	(D)	(D)	11
Industrial chemicals..............................	281-82,286	84	0	(D)	(D)	(D)	(D)	(D)
Drugs and medicines...............................	283	(D)	(D)	(D)	(D)	0	(D)	(D)
Other chemicals...................................	284-85,287-89	(D)	0	(D)	(D)	0	0	0
Petroleum refining and extraction...................	13,29	(S)	0	0	(D)	(D)	(D)	(D)
Rubber products.....................................	30	(D)	0	0	(D)	(D)	0	0
Stone, clay, and glass products.....................	32	(D)	0	0	0	0	2	(D)
Primary metals......................................	33	34	(D)	(D)	(D)	(D)	(D)	(D)
Ferrous metals and products.......................	331-32,3398-99	(D)	0	(D)	(D)	(D)	0	(D)
Nonferrous metals and products....................	333-36	(D)	(D)	0	(D)	0	(D)	(D)
Fabricated metal products...........................	34	135	(D)	0	(D)	(D)	93	0
Machinery...	35	(D)	(S)	0	37	(D)	(D)	(D)
Office, computing, and accounting machines........	357	(D)	0	0	(D)	(D)	(D)	(D)
Other machinery, except electrical................	351-56,358-59	106	(S)	0	(D)	(D)	(D)	(D)
Electrical equipment................................	36	5,222	(S)	48	171	160	391	4,403
Radio and TV receiving equipment..................	365	0	0	0	0	0	0	0
Communication equipment...........................	366	4,666	(D)	0	133	(D)	362	4,040
Electronic components.............................	367	522	(S)	(D)	(D)	(D)	(D)	(D)
Other electrical equipment........................	361-64,369	34	(D)	(D)	(D)	(D)	(D)	(D)
Transportation equipment............................	37	21,763	0	(D)	(D)	14	657	(D)
Motor vehicles and motor vehicles equipment.......	371	(D)	0	0	(D)	0	(D)	(D)
Other transportation equipment....................	373-75,379	(D)	0	0	0	0	(D)	0
Aircraft and missiles.............................	372,376	19,634	0	(D)	(D)	14	(D)	18,947

See footnotes at end of

Table B-13. Federal funds for industrial R&D performance, by industry, by size of company: 1989 (continued)

[Dollars in millions]

Industry	SIC code	Total 1989	Size of company					
			Less than 500 employees	500 to 999 employees	1,000 to 4,999 employees	5,000 to 9,999 employees	10,000 to 24,999 employees	25,000 or more employees
Professional and scientific instruments.............	38	$125	$7	(D)	(D)	(D)	(D)	(D)
Scientific and mechanical measuring instruments...	381-82	(S)	(D)	0	0	0	(D)	0
Optical, surgical, photographic, and other instruments..	383-87	115	(D)	(D)	(D)	(D)	(D)	(D)
Other manufacturing industries......................	27,31,39	(D)	0	(D)	(D)	0	0	0
Nonmanufacturing industries..........................	10-11,14-17,40-42,44-51,53-54,56,60,62-63,72-73,78,806-07,87	2,716	878	29	734	(D)	(D)	(D)

(D) Data have been withheld to avoid disclosing operations of individual companies.
(S) Data have been withheld due to imputation of more than 50 percent.

SOURCE: National Science Foundation, SRS

Table B-14. Federal funds for research and development, by agency, by selected industry in selected years.

[Dollars in millions]

Industry	SIC code	1973	1974	1975	1976	1977	1979	1981	1983	1985	1987	1989
All agencies												
Total		$8,145	$8,220	$8,605	$9,561	$10,485	$12,518	$16,382	$20,657	$27,130	$31,403	$31,366
Chemicals and allied products	28	203	214	236	266	295	346	421	393	230	193	87
Machinery	35	429	511	509	532	477	335	694	1,116	1,495	(D)	(D)
Electrical equipment	36	2,410	2,307	2,307	2,555	2,648	3,309	3,920	4,684	5,521	5,859	5,222
Motor vehicles and other transportation Equipment	371,373-75,379	424	335	365	(1)	(1)	(1)	(1)	(1)	820	2,265	2,129
Aircraft and missiles	372,376	3,889	4,003	4,434	4,930	5,486	5,840	8,528	11,103	15,628	17,665	19,634
Other industries	--	790	850	754	(1)	(1)	(1)	(1)	(1)	3,436	(D)	(D)
DOD (2)												
Total		$6,088	$5,919	$5,812	$6,222	$6,950	$7,939	$10,540	$14,587	$20,997	$21,800	(S)
Chemicals and allied products	28	48	39	27	28	32	36	40	48	(S)	(D)	(S)
Machinery	35	302	426	405	442	395	541	599	963	1,287	(D)	(D)
Electrical equipment	36	1,770	1,643	1,570	1,607	1,692	1,920	2,338	3,166	4,078	(S)	3,110
Motor vehicles and other transportation Equipment	371,373-75,379	325	251	288	337	382	(1)	(1)	(1)	(D)	(D)	(D)
Aircraft and missiles	372,376	3,077	2,992	3,120	3,408	3,900	4,210	6,121	8,659	13,117	13,084	(S)
Other industries	--	566	568	402	400	461	(1)	(1)	(1)	(D)	2,741	1,924
NASA (2)												
Total		$982	$1,095	$1,409	$1,604	$1,697	$1,786	$2,306	$2,152	(S)	$2,748	(S)
Chemicals and allied products	28	1	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(S)	(D)	0
Machinery	35	78	63	62	62	54	74	81	(1)	(D)	(D)	(D)
Electrical equipment	36	181	162	186	200	208	252	317	195	96	125	(D)
Motor vehicles and other transportation Equipment	371,373-75,379	45	25	27	(1)	(1)	(1)	(1)	(1)	(S)	(D)	(D)
Aircraft and missiles	372,376	617	789	1,082	1,267	1,348	1,221	1,785	1,909	(S)	2,528	(S)
Other industries	--	60	(1)	(1)	45	44	119	70	(1)	(D)	52	39
DOE												
Total		(3)	(3)	(3)	(3)	(3)	$1,575	$1,976	$1,951	$2,908	$2,908	$3,530
Chemicals and allied products	28	(3)	(3)	(3)	(3)	(3)	(1)	(1)	(1)	(S)	174	(S)
Machinery	35	(3)	(3)	(3)	(3)	(3)	(1)	(1)	(1)	(S)	(D)	(S)
Electrical equipment	36	(3)	(3)	(3)	(3)	(3)	784	951	950	1,271	1,285	1,888
Motor vehicles and other transportation Equipment	371,373-75,379	(3)	(3)	(3)	(3)	(3)	16	20	28	(S)	(D)	0
Aircraft and missiles	372,376	(3)	(3)	(3)	(3)	(3)	253	340	202	441	656	(S)
Other industries	--	(3)	(3)	(3)	(3)	(3)	287	356	281	575	778	(S)

(D) Data have been withheld to avoid disclosing operations of individual companies.
(S) Data have been withheld due to imputation of 50 percent or more.
(1) Not separately available but included in total. See general notes.
(2) For 1973-74, funds were based on approximately 175 companies leading in Federal R&D funds; 1975-89 funds are based on all companies reporting Federal R&D fun
(3) Data not tabulated for this agency prior to 1979.

SOURCE: National Science Foundation, SRS

Table B-15. Number of R&D-performing companies reporting Federal R&D funds, by industry, by size of company: 1989

Industry	SIC code	Size of company: Less than 500 employees Total	Less than 500 employees Federal	500 to 999 employees Total	500 to 999 employees Federal	1,000 to 4,999 employees Total	1,000 to 4,999 employees Federal	5,000 to 9,999 employees Total	5,000 to 9,999 employees Federal	10,000 to 24,999 employees Total	10,000 to 24,999 employees Federal	25,000 or more employees Total	25,000 or more employees Federal
Total	....	22,486	1,235	761	36	1,043	66	187	25	175	42	123	47
Food, kindred, and tobacco products	20,21	8	0	35	0	48	0	14	1	13	0	15	0
Textiles and apparel	22,23	286	1	106	0	44	0	8	0	9	0	4	0
Lumber, wood products, and furniture	24,25	78	0	27	0	37	0	7	0	4	0	1	0
Paper and allied products	26	261	0	13	0	32	0	9	0	8	0	3	0
Chemicals and allied products	28	2,325	100	39	3	68	8	9	2	21	4	9	6
Industrial chemicals	281-82,286	204	0	11	1	23	6	6	2	4	2	5	4
Drugs and medicines	283	407	100	6	1	12	1	1	0	10	2	3	2
Other chemicals	284-85,287-89	1,714	0	22	1	33	1	2	0	7	0	1	0
Petroleum refining and extraction	13,29	104	0	3	0	11	1	5	2	4	2	7	2
Rubber products	30	308	0	35	0	133	1	5	1	6	0	1	0
Stone, clay, and glass products	32	86	0	26	0	29	0	6	0	6	3	2	1
Primary metals	33	169	2	23	1	41	4	10	1	7	2	3	2
Ferrous metals and products	331-32,3398-99	79	0	10	1	20	1	7	1	3	0	2	1
Nonferrous metals and products	333-36	89	2	13	0	21	3	3	0	4	2	1	1
Fabricated metal products	34	1,907	1	57	0	60	2	10	1	7	3	0	0
Machinery	35	2,535	61	98	0	124	10	26	3	11	2	7	3
Office, computing, and accounting machines	357	431	0	24	0	28	3	11	1	3	1	4	2
Other machinery, except electrical	351-56,358-59	2,104	61	74	0	96	7	15	2	8	1	3	1
Electrical equipment	36	3,424	113	104	15	114	18	15	5	15	7	15	11
Radio and TV receiving equipment	365	172	0	3	0	3	0	1	0	0	0	0	0
Communication equipment	366	613	4	15	0	20	10	4	2	4	4	9	7
Electronic components	367	1,267	107	35	2	38	7	4	2	5	2	2	3
Other electrical equipment	361-64,369	1,372	2	51	13	53	1	6	1	6	1	4	1
Transportation equipment	37	150	0	32	2	45	5	9	3	16	9	18	16
Motor vehicles and motor vehicles equipment	371	100	0	19	0	25	1	5	0	6	2	4	2
Other transportation equipment	373-75,379	49	0	6	0	9	0	0	0	4	3	0	0
Aircraft and missiles	372,376	1	0	7	2	11	4	4	3	6	4	14	14

See footnotes at end of

Table B-15. Number of R&D-performing companies reporting Federal R&D funds, by industry, by size of company: 1989 (continued)

Industry	SIC code	Size of company											
		Less than 500 employees		500 to 999 employees		1,000 to 4,999 employees		5,000 to 9,999 employees		10,000 to 24,999 employees		25,000 or more employees	
		Total	Federal	Total	Federal	Total	Federal	Total	Federal	Total	Federal	Total	Federal
Professional and scientific instruments	38	1,808	18	38	2	44	3	10	1	3	2	4	2
Scientific and mechanical measuring instruments..........................	381-82	979	17	15	0	18	0	5	0	1	1	0	0
Optical, surgical, photographic, and other instruments...................	383-87	829	1	23	2	26	3	5	1	2	1	4	2
Other manufacturing industries.........	27,31,39	310	0	36	2	38	1	7	0	7	0	0	0
Nonmanufacturing industries............	10-11,14-17,40-42,44-51,53-54,56,60,62-63,72-73,78,806-07,87	8,727	939	89	11	175	13	37	5	38	8	34	4

SOURCE: National Science Foundation, SRS

Table B-16. Industry-administered federally funded R&D centers--funds by character of work, full-time-equivalent (FTE) R&D scientists and engineers, and total number of employees: 1987-89

[Dollars in millions]

Item	1987	1988	1989
Total R&D funds..........	$2,351	$2,538	$2,663
Basic research.........	142	337	418
Applied research.......	705	466	465
Development............	1,504	1,735	1,781
		January	
	1988	1989	1990
Number of FTE R&D scientists and engineers	11,624	14,370	15,285
		March	
	1987	1988	1989
Total employment.........	39,546	41,277	40,699

NOTE: Industry-administered Federally funded research and development centers centers (FFRDCs) conduct R&D almost exclusively for use by the Federal Government. Data for these FFRDCs administered by industry are included in Federal R&D support under the industry classifications of the administering firms. See section C for a listing of industry-administered FFRDCs and their locations.

SOURCE: National Science Foundation, SRS

Table B-17. Number of R&D-performing companies in manufacturing and nonmanufacturing industries, by size of company: 1989

Size of company [Based on number of employees]	Number of companies reporting R&D funds		
	Total	Manu-facturing	Nonmanu-facturing
Total...............	24,775	15,675	9,100
Less than 500............	22,486	13,759	8,727
500 to 999...............	761	672	89
1,000 to 4,999...........	1,043	868	175
5,000 to 9,999...........	187	150	37
10,000 to 24,999.........	175	137	38
25,000 or more...........	123	89	34

SOURCE: National Science Foundation, SRS

Table B-18. Concentration of total, Federal, and company and other R&D funds, and net sales of R&D-performing companies: 1979-89

Companies ranked by size of R&D program (1)	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
	Percent of total (company, Federal, and other) R&D funds ranked by size of total R&D funds										
First 4 (1-4)	20 %	17 %	18 %	20 %	19 %	17 %	18 %	19 %	19 %	18 %	19 %
Next 4 (5-8)	13	14	12	12	11	13	12	11	12	12	12
Next 12 (9-20)	19	18	20	19	17	17	17	14	16	17	17
Next 20 (21-40)	13	13	12	13	13	13	13	13	12	12	12
Next 60 (41-100)	15	15	18	16	17	18	16	15	14	15	15
Next 100 (101-200)	9	9	9	9	9	9	9	10	8	8	8
Next 200 (201-400)	6	6	6	6	6	6	5	8	6	7	7
	Percent of Federal R&D funds ranked by size of Federal R&D funds										
First 4 (1-4)	(2)	(2)	(2)	(2)	(2)	30 %	29 %	30 %	31 %	32 %	36 %
Next 4 (5-8)	(2)	(2)	(2)	(2)	(2)	15	15	16	18	18	16
Next 12 (9-20)	(2)	(2)	(2)	(2)	(2)	26	27	28	27	28	30
Next 20 (21-40)	(2)	(2)	(2)	(2)	(2)	17	16	15	15	15	12
Next 60 (41-100)	(2)	(2)	(2)	(2)	(2)	10	7	7	7	6	6
Next 100 (101-200)	(2)	(2)	(2)	(2)	(2)	1	2	2	1	3	1
Next 200 (201-400)	(2)	(2)	(2)	(2)	(2)	0	0	1	0	0	0
	Percent of company and other (except Federal) R&D funds ranked by size of company and other R&D funds										
First 4 (1-4)	(2)	(2)	(2)	(2)	(2)	22 %	23 %	20 %	20 %	21 %	22 %
Next 4 (5-8)	(2)	(2)	(2)	(2)	(2)	8	7	7	7	7	7
Next 12 (9-20)	(2)	(2)	(2)	(2)	(2)	12	12	12	12	12	13
Next 20 (21-40)	(2)	(2)	(2)	(2)	(2)	12	12	10	11	12	12
Next 60 (41-100)	(2)	(2)	(2)	(2)	(2)	18	18	16	16	16	16
Next 100 (101-200)	(2)	(2)	(2)	(2)	(2)	11	10	10	10	10	10
Next 200 (201-400)	(2)	(2)	(2)	(2)	(2)	7	7	8	8	8	8
	Percent of net sales ranked by size of total R&D funds										
First 4 (1-4)	(2)	(2)	(2)	(2)	(2)	7 %	8 %	8 %	7 %	7 %	7 %
Next 4 (5-8)	(2)	(2)	(2)	(2)	(2)	4	4	5	5	5	4
Next 12 (9-20)	(2)	(2)	(2)	(2)	(2)	5	5	5	5	5	5
Next 20 (21-40)	(2)	(2)	(2)	(2)	(2)	8	8	7	7	6	6
Next 60 (41-100)	(2)	(2)	(2)	(2)	(2)	12	12	10	11	11	12
Next 100 (101-200)	(2)	(2)	(2)	(2)	(2)	13	13	10	8	9	9
Next 200 (201-400)	(2)	(2)	(2)	(2)	(2)	14	15	9	12	10	10

(1) Companies were ranked individually for each year; therefore, particular companies comprising the size groups may have changed from year to year.
(2) Data not collected

SOURCE: National Science Foundation, SRS

Table B-19. Domestic net sales of R&D-performing companies, by industry, by size of company: 1988-89

[Dollars in millions]

Industry	SIC code		1988 Size of company					
		Total funds	Less than 500 employees	500 to 999 employees	1,000 to 4,999 employees	5,000 to 9,999 employees	10,000 to 24,999 employees	25,000 or more employees
Total....................................	....	$2,408,892	(S)	(S)	$331,173	$224,244	$467,402	$1,153,432
Food, kindred, and tobacco products...............	20,21	243,877	(S)	(S)	30,761	28,365	42,038	136,448
Textiles and apparel..............................	22,23	(S)	(S)	(S)	7,667	4,619	11,743	17,568
Lumber, wood products, and furniture...............	24,25	23,359	(D)	(S)	9,469	3,011	5,408	(D)
Paper and allied products..........................	26	89,459	(S)	(S)	(S)	9,928	31,450	32,630
Chemicals and allied products......................	28	199,888	(S)	5,155	37,347	15,462	64,975	64,197
Industrial chemicals............................	281-82,286	88,481	(S)	1,626	11,768	9,579	17,135	47,079
Drugs and medicines.............................	283	52,823	(S)	570	7,693	(D)	33,036	(D)
Other chemicals.................................	284-85,287-89	58,584	(S)	2,959	17,886	(D)	14,804	(D)
Petroleum refining and extraction..................	13,29	198,264	(S)	(S)	(S)	16,071	40,896	126,594
Rubber products....................................	30	39,311	(D)	(S)	9,507	5,023	9,856	(D)
Stone, clay, and glass products....................	32	37,857	(D)	(S)	(S)	4,163	13,721	(D)
Primary metals.....................................	33	80,023	(S)	(S)	16,866	11,939	18,525	27,655
Ferrous metals and products......................	331-32,3398-99	44,411	(S)	(S)	(S)	(D)	7,735	(D)
Nonferrous metals and products...................	333-36	35,612	(S)	(S)	10,491	(D)	10,790	(D)
Fabricated metal products..........................	34	65,544	(S)	(S)	(S)	8,690	20,990	0
Machinery..	35	167,239	(S)	20,772	36,092	18,164	20,266	51,517
Office, computing, and accounting machines.......	357	81,801	(D)	14,487	12,165	7,723	5,050	(D)
Other machinery, except electrical...............	351-56,358-59	85,438	(D)	6,285	23,927	10,441	15,216	(D)
Electrical equipment...............................	36	207,757	(S)	7,744	25,679	12,166	31,823	108,554
Radio and TV receiving equipment.................	365	4,607	(S)	(D)	(S)	0	(D)	0
Communication equipment..........................	366	104,931	4,755	(D)	5,114	6,142	(D)	80,542
Electronic components............................	367	48,306	(S)	2,200	7,180	3,256	8,283	17,781
Other electrical equipment.......................	361-64,369	49,913	(S)	4,272	12,111	2,768	13,689	10,231
Transportation equipment...........................	37	406,673	(S)	(S)	15,954	19,104	29,554	333,308
Motor vehicles and motor vehicles equipment......	371	225,548	(D)	(S)	10,657	(D)	6,880	188,035
Other transportation equipment...................	373-75,379	14,803	(D)	(S)	2,585	(D)	8,517	0
Aircraft and missiles............................	372,376	166,322	(D)	(S)	2,712	(D)	14,157	145,273

See footnotes at end of

Table B-19. Domestic net sales of R&D-performing companies, by industry, by size of company: 1988-89 (continued)

[Dollars in millions]
1988
Size of company

Industry	SIC code	Total funds	Less than 500 employees	500 to 999 employees	1,000 to 4,999 employees	5,000 to 9,999 employees	10,000 to 24,999 employees	25,000 or more employees
Professional and scientific instruments	38	$72,320	(S)	(S)	$10,764	$3,491	$5,943	$40,857
Scientific and mechanical measuring instruments	381-82	20,417	(S)	$1,086	4,325	(D)	(D)	(D)
Optical, surgical, photographic, and other instruments	383-87	51,903	(S)	(S)	6,439	(D)	(D)	(D)
Other manufacturing industries	27,31,39	35,115	(D)	(S)	12,560	4,316	11,051	(D)
Nonmanufacturing industries	10-11,14-17,40-42,44-51,53-54,56,60,62-63,72-73,78,806-07,87	486,956	(S)	(S)	(S)	(S)	109,163	194,022

[Dollars in millions]
1989
Size of company

Industry	SIC code	Total funds	Less than 500 employees	500 to 999 employees	1,000 to 4,999 employees	5,000 to 9,999 employees	10,000 to 24,999 employees	25,000 or more employees
Total		$2,511,775	(S)	(S)	$350,218	$237,415	$464,335	$1,219,421
Food, kindred, and tobacco products	20,21	258,203	(S)	(S)	31,766	30,622	43,780	145,724
Textiles and apparel	22,23	(S)	(S)	(S)	7,975	(S)	12,686	18,489
Lumber, wood products, and furniture	24,25	25,111	(D)	(S)	9,466	3,900	5,576	(D)
Paper and allied products	26	95,354	(S)	(S)	(S)	9,705	31,494	35,574
Chemicals and allied products	28	214,405	(S)	5,762	43,618	13,077	63,768	74,514
Industrial chemicals	281-82,286	92,879	(S)	1,798	14,214	9,894	15,985	49,655
Drugs and medicines	283	55,691	(S)	605	8,632	(D)	31,208	(D)
Other chemicals	284-85,287-89	65,835	(S)	3,359	20,772	(D)	16,575	(D)
Petroleum refining and extraction	13,29	214,660	(D)	(D)	(S)	18,152	41,135	140,615
Rubber products	30	40,447	(D)	(S)	9,926	3,742	11,826	(D)
Stone, clay, and glass products	32	38,002	(D)	(S)	(S)	(S)	13,311	(D)
Primary metals	33	84,198	(S)	(S)	15,690	13,554	19,292	30,194
Ferrous metals and products	331-32,3398-99	46,319	(D)	(S)	(S)	7,324	6,835	(D)
Nonferrous metals and products	333-36	37,879	(D)	(S)	8,959	6,230	12,457	(D)
Fabricated metal products	34	60,745	(S)	(S)	(S)	10,095	12,268	0

See footnotes at end of

Table B-19. Domestic net sales of R&D-performing companies, by industry, by size of company: 1988-89 (continued)

[Dollars in millions]
1989
Size of company

Industry	SIC code	Total funds	Less than 500 employees	500 to 999 employees	1,000 to 4,999 employees	5,000 to 9,999 employees	10,000 to 24,999 employees	25,000 or more employees
Machinery..	35	$168,984	(S)	$17,030	$33,481	$23,793	19,736	$54,372
Office, computing, and accounting machines.......	357	78,837	$3,162	10,925	6,967	13,486	4,701	39,597
Other machinery, except electrical..............	351-56,358-59	90,147	(S)	6,105	26,514	10,307	15,035	14,775
Electrical equipment..............................	36	217,146	(S)	8,244	28,207	14,086	26,907	115,934
Radio and TV receiving equipment.................	365	2,968	(S)	(D)	(D)	(D)	0	0
Communication equipment..........................	366	107,792	(S)	(D)	(D)	(D)	5,423	85,539
Electronic components............................	367	52,690	(S)	(S)	11,160	2,902	7,186	18,720
Other electrical equipment.......................	361-64,369	53,696	(S)	4,915	11,343	(S)	14,298	11,675
Transportation equipment..........................	37	408,687	(S)	(S)	18,186	12,578	33,983	334,701
Motor vehicles and motor vehicles equipment......	371	227,856	(D)	(D)	12,533	(S)	14,359	186,790
Other transportation equipment...................	373-75,379	15,517	(S)	(S)	(S)	0	9,908	0
Aircraft and missiles............................	372,376	165,314	(D)	(D)	2,603	4,415	9,716	147,911
Professional and scientific instruments...........	38	78,213	(S)	3,026	10,199	6,147	3,970	45,984
Scientific and mechanical measuring instruments..	381-82	21,913	(D)	963	3,811	2,663	(D)	(D)
Optical, surgical, photographic, and other instruments....................................	383-87	56,300	(D)	(S)	6,388	3,484	(D)	(D)
Other manufacturing industries....................	27,31,39	38,774	(S)	(S)	13,890	5,300	13,846	0
Nonmanufacturing industries.......................	10-11,14-17,40-42,44-51,53-54,56,60,62-63,72-73,78,806-07,87	510,403	(S)	(S)	(S)	64,288	110,758	204,597

(S) Data have been withheld due to imputation of 50 percent of more.
(D) Data have been withheld to avoid disclosing operations of individual companies.

SOURCE: National Science Foundation, SRS

Table B-20. Total (company, Federal, and other) R&D funds as a percent of net sales in R&D-performing manufacturing companies, by industry and size of company: selected years

[Percent]

Industry and size of company	SIC code	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Total..	....	2.6	3.0	3.1	3.8	3.9	3.9	4.4	4.7	4.6	4.7	4.7
Distribution by industry												
Food, kindred, and tobacco products(1)..............	20,21	0.4	0.4	(D)	(D)	(D)	(D)	(D)	(D)	0.6	(D)	(D)
Textiles and apparel................................	22,23	0.4	0.4	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
Lumber, wood products, and furniture................	24,25	0.7	0.8	0.8	0.8	0.8	0.7	0.8	0.6	0.6	(D)	0.7
Paper and allied products...........................	26	1.0	1.0	(D)	1.1	(D)	(D)	(D)	(D)	(D)	(D)	0.7
Chemicals and allied products.......................	28	3.5	3.6	3.6	4.3	4.4	4.7	5.0	5.2	5.3	5.4	5.4
Industrial chemicals..............................	281-82,286	3.2	3.3	3.2	4.0	3.9	4.0	4.4	4.6	4.7	4.5	4.4
Drugs and medicines...............................	283	6.1	6.2	(D)	(D)	(D)	(D)	(D)	8.5	(D)	9.0	(D)
Other chemicals...................................	284-85,287-89	1.8	1.9	(D)	(D)	(D)	(D)	(D)	3.3	(D)	3.5	(D)
Petroleum refining and extraction...................	13,29	0.7	0.6	(D)	(D)	(D)	(D)	(D)	(D)	1.0	1.0	1.0
Rubber products.....................................	30	1.9	2.2	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
Stone, clay, and glass products.....................	32	1.3	1.4	(D)	(D)	(D)	(D)	(D)	2.5	2.6	(D)	(D)
Primary metals......................................	33	0.6	0.7	0.9	1.1	1.3	(D)	(D)	(D)	0.9	0.8	0.9
Ferrous metals and products.......................	331-32,3398-99	0.6	0.7	(D)	(D)	(D)	(D)	(D)	(D)	(D)	0.6	(D)
Nonferrous metals and products....................	333-36	0.7	0.7	(D)	(D)	(D)	1.2	1.4	1.5	(D)	1.1	(D)
Fabricated metal products...........................	34	1.1	1.4	1.4	1.3	1.4	1.5	1.5	1.5	1.5	1.3	1.3
Machinery...	35	4.5	5.0	4.9	5.6	6.2	6.4	7.6	(D)	(D)	(D)	(D)
Office, computing, and accounting machines........	357	11.0	12.0	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
Other machinery, except electrical................	351-56,358-59	2.1	2.3	(D)	(D)	(D)	(D)	(D)	3.0	3.0	3.2	3.1
Electrical equipment................................	36	6.0	6.6	6.8	7.2	7.9	6.8	7.6	7.9	8.2	7.8	7.7
Radio and TV receiving equipment..................	365	2.5	4.3	(D)	(D)	(D)	(D)	(D)	3.6	3.2	3.0	2.9
Communication equipment...........................	366	8.8	9.1	9.6	11.0	11.5	9.8	10.1	9.9	10.2	9.8	9.7
Electronic components.............................	367	7.1	7.9	7.4	6.8	7.7	7.8	9.6	(D)	10.0	9.5	9.3
Other electrical equipment........................	361-64,369	4.9	4.9	(D)	(D)	(D)	(D)	(D)	(D)	2.7	2.4	2.4
Transportation equipment............................	37						(D)	(D)	8.3	8.7	8.9	9.0
Motor vehicles and motor vehicles equipment.......	371	3.8	4.9	4.5	4.5	4.0	3.4	3.8	(D)	(D)	(D)	(D)
Other transportation equipment....................	373-75,379	0.8	0.6	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
Aircraft and missiles.............................	372,376	12.9	13.7	16.0	17.1	15.2	15.4	14.9	13.4	14.7	15.6	15.5

See footnotes at end of

Table B-20. Total (company, Federal, and other) R&D funds as a percent of net sales in R&D-performing manufacturing companies, by industry and size of company: selected years (continued)

[Percent]

Industry and size of company	SIC code	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Professional and scientific instruments.............	38	7.3	7.5	8.1	8.4	8.6	8.3	8.9	8.8	7.9	7.5	7.4
Scientific and mechanical measuring instruments...	381-82	7.3	8.4	(D)	(D)	(D)	(D)	(D)	(D)	(D)	8.5	8.5
Optical, surgical, photographic, and other instruments......................................	383-87	7.2	6.9	(D)	(D)	(D)	(D)	(D)	(D)	(D)	7.1	6.9
Other manufacturing industries (1)..................	27,31,39	0.4	0.4	(D)	(D)	(D)	(D)	(D)	1.2	(D)	(D)	(D)
Distribution by size of company [Based on number of employees]												
Less than 500.......................................	....	1.6	1.4	1.5	1.8	2.5	2.9	3.6	4.1	3.9	3.6	3.5
500 to 999..	....						2.3	2.4	2.4	2.3	2.2	2.3
1,000 to 4,999......................................	....	1.8	1.8	1.7	1.9	2.0	2.2	2.6	2.5	2.6	2.5	2.5
5,000 to 9,999......................................	....	1.3	1.4	2.1	1.7	1.7	1.8	1.9	2.3	2.3	2.3	2.5
10,000 to 24,999....................................	....	1.7	1.7	1.9	2.4	2.8	3.1	3.1	3.2	3.1	3.1	3.0
25,000 or more......................................	....	3.8	4.0	4.6	5.4	5.5	5.3	6.2	6.5	6.6	6.6	6.7

(D) Data have been withheld to avoid disclosing operations of individual companies.
(1) Until 1984, tobacco products, SIC 21, was included with "other manufacturing industries."

SOURCE: National Science Foundation, SRS

Table B-21. Company and other (except Federal) R&D funds as a percent of net sales in R&D-performing manufacturing companies, by industry and size of company: 1979-89

Industry and size of company	SIC code	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Total		1.9 %	2.1 %	2.2 %	2.6 %	2.6 %	2.6 %	3.0 %	3.2 %	3.1 %	3.1 %	3.1 %
Distribution by industry												
Food, kindred, and tobacco products(1)	20,21	(D)	(D)	0.4	0.4	0.4	0.4	0.6	0.6	0.6	0.5	0.5
Textiles and apparel	22,23	(D)	(D)	0.4	0.5	0.4	0.5	0.5	0.5	0.4	0.4	0.4
Lumber, wood products, and furniture	24,25	0.7	0.8	0.8	0.8	0.8	0.7	0.8	0.6	0.6	0.7	0.7
Paper and allied products	26	(D)	1.0	1.0	1.1	0.9	0.8	0.8	0.7	0.6	0.7	0.7
Chemicals and allied products	28	3.2	3.3	3.4	4.0	4.2	4.6	4.9	5.1	5.2	5.3	5.3
Industrial chemicals	281-82,286	2.6	2.8	2.8	3.5	3.4	3.8	4.2	4.4	4.4	4.3	4.3
Drugs and medicines	283	(D)	6.1	6.3	7.0	7.7	8.2	8.0	8.4	8.7	9.0	9.3
Other chemicals	284-85,287-89	(D)	1.9	2.1	2.3	2.5	2.9	3.1	3.3	3.3	3.5	3.5
Petroleum refining and extraction	13,29	0.6	0.5	0.6	0.8	0.7	0.7	0.9	1.1	1.0	1.0	1.0
Rubber products	30	(D)	(D)	1.9	1.7	1.7	1.9	1.8	1.7	1.6	1.6	1.7
Stone, clay, and glass products	32	(D)	1.3	1.4	1.7	1.9	1.9	2.3	2.4	2.5	2.2	2.3
Primary metals	33	0.5	0.5	0.7	0.8	0.8	0.9	0.9	1.0	0.9	0.8	0.9
Ferrous metals and products	331-32,3398-99	0.5	0.5	0.6	0.6	0.6	0.6	0.5	0.7	0.6	0.6	0.6
Nonferrous metals and products	333-36	0.6	0.6	1.0	1.3	1.2	1.2	1.4	1.5	1.3	1.1	1.2
Fabricated metal products	34	1.0	1.2	1.2	1.2	1.3	1.4	1.4	1.4	1.2	1.0	1.1
Machinery	35	4.2	4.5	4.4	5.0	5.4	5.8	6.7	7.3	7.1	7.2	7.8
Office, computing, and accounting machines	357	10.1	10.4	9.7	10.4	10.0	10.5	12.4	12.4	12.3	11.5	13.4
Other machinery, except electrical	351-56,358-59	2.0	2.2	2.3	2.4	2.4	2.5	2.6	2.9	3.0	3.1	3.0
Electrical equipment	36	3.6	3.9	4.2	4.4	5.0	4.5	4.8	5.1	5.4	5.2	5.3
Radio and TV receiving equipment	365	1.7	2.7	2.6	3.3	2.9	3.7	4.3	3.6	3.2	3.0	2.9
Communication equipment	366	5.0	5.4	6.0	6.7	7.2	5.1	5.4	5.2	5.5	5.4	5.4
Electronic components	367	(D)	5.9	5.7	5.2	6.6	6.6	8.2	9.2	8.5	8.0	8.3
Other electrical equipment	361-64,369	(D)	2.5	2.8	2.3	2.6	2.2	2.0	2.2	2.6	2.4	2.3
Transportation equipment	37						3.3	3.4	3.6	3.4	3.5	3.7
Motor vehicles and motor vehicles equipment	371	3.2	4.2	3.9	4.0	3.5	3.0	3.1	3.3	3.4	3.4	3.8
Other transportation equipment	373-75,379	(D)	0.3	0.3	0.7	1.7	2.0	2.3	2.7	2.5	2.5	2.3
Aircraft and missiles	372,376	3.5	3.8	4.6	5.1	4.1	4.0	3.9	4.0	3.6	3.6	3.6

See footnotes at end of

Table B-21. Company and other (except Federal) R&D funds as a percent of net sales in R&D-performing manufacturing companies, by industry and size of company: 1979-89 (continued)

Industry and size of company	SIC code	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Professional and scientific instruments.............	38	5.8 %	6.1 %	6.7 %	7.3 %	7.7 %	7.6 %	8.3 %	8.2 %	7.5 %	7.3 %	7.2 %
Scientific and mechanical measuring instruments...	381-82	5.8	6.2	6.9	7.6	8.8	8.3	8.4	8.4	8.1	8.4	8.5
Optical, surgical, photographic, and other instruments.......................................	383-87	5.9	6.0	6.6	7.1	7.1	7.3	8.1	8.0	7.2	6.9	6.7
Other manufacturing industries (1)..................	27,31,39	0.4	0.4	0.4	0.8	1.0	1.1	1.0	1.2	1.1	1.1	1.0
Distribution by size of company [Based on number of employees]												
Less than 500......................................		1.5	1.2	1.4	1.6	2.2	2.8	3.4	4.0	3.8	3.6	3.5
500 to 999...							2.2	2.2	2.2	2.2	2.1	2.1
1,000 to 4,999.....................................		1.4	1.4	1.5	1.7	2.0	2.0	2.4	2.4	2.4	2.1	2.1
5,000 to 9,999.....................................		1.1	1.1	1.7	1.5	1.3	1.6	1.8	2.0	2.0	2.3	2.5
10,000 to 24,999...................................		1.4	1.4	1.6	2.0	2.3	2.5	2.5	2.6	2.5	2.6	2.5
25,000 or more.....................................		2.4	2.5	2.7	3.3	3.4	3.2	3.5	3.7	3.8	3.8	3.8

(1) Until 1984, tobacco products, SIC 21, was included with "other manufacturing industries."
(D) Data have been withheld to avoid disclosing operations of individual companies.

SOURCE: National Science Foundation, SRS

Table B-22. Total (company, Federal, and other) R&D funds as a percent of net sales in R&D-performing manufacturing companies ranked by size of R&D program, by industry: 1989

Industry	SIC code	Total R&D funds as a percent of net sales [Percent]			Total R&D funds [Dollars in millions]		
		First 4 companies	Next 4 companies	Next 12 companies	First 4 companies	Next 4 companies	Next 12 companies
Total		11.2 %	12.3 %	13.1 %	$20,012	$12,519	$16,668
Food, kindred, and tobacco products	20,21	0.9	1.1	0.5	559	197	296
Textiles and apparel	22,23	(S)	0.3	0.4	86	35	39
Lumber, wood products, and furniture	24,25	1.4	0.8	0.7	89	23	32
Paper and allied products	26	1.1	1.0	0.7	310	120	138
Chemicals and allied products	28	7.1	7.5	6.7	3,025	1,871	3,069
Industrial chemicals	281-82,286	6.0	2.9	3.7	2,558	561	663
Drugs and medicines	283	12.3	9.1	9.1	2,135	1,911	1,676
Other chemicals	284-85,287-89	5.0	2.8	2.0	1,085	217	233
Petroleum refining and extraction	13,29	1.4	0.9	0.5	1,233	546	271
Rubber products	30	3.6	2.7	1.5	423	78	98
Stone, clay, and glass products	32	4.5	1.8	1.0	676	104	68
Primary metals	33	0.9	(D)	1.1	302	120	202
Ferrous metals and products	331-32,3398-99	(D)	1.0	0.8	128	65	57
Nonferrous metals and products	333-36	2.0	1.8	0.7	291	96	83
Fabricated metal products	34	4.4	1.8	1.1	342	108	89
Machinery	35	21.1	9.7	7.6	8,484	1,263	1,538
Office, computing, and accounting machines	357	21.1	16.9	8.4	8,484	1,037	1,074
Other machinery, except electrical	351-56,358-59	5.0	6.3	3.3	873	238	358
Electrical equipment	36	12.5	9.4	9.3	7,235	2,529	2,859
Radio and TV receiving equipment	365	3.4	(S)	(S)	62	(S)	(S)
Communication equipment	366	11.6	10.1	6.4	6,283	1,223	1,011
Electronic components	367	12.2	13.6	10.8	2,506	623	583
Other electrical equipment	361-64,369	5.1	2.0	1.8	376	171	228
Transportation equipment	37	8.2	21.6	10.3	16,875	10,082	8,759
Motor vehicles and motor vehicles equipment	371	(D)	(S)	0.7	(D)	117	118
Other transportation equipment	373-75,379	3.8	(S)	(S)	376	17	(S)
Aircraft and missiles	372,376	20.7	14.1	12.6	18,134	7,408	4,885

See footnotes at end of

Table B-22. Total (company, Federal, and other) R&D funds as a percent of net sales in R&D-performing manufacturing companies ranked by size of R&D program, by industry: 1989 (continued)

Industry	SIC code	Total R&D funds as a percent of net sales [Percent]			Total R&D funds [Dollars in millions]		
		First 4 companies	Next 4 companies	Next 12 companies	First 4 companies	Next 4 companies	Next 12 companies
Professional and scientific instruments..............	38	9.0 %	6.6 %	9.0 %	$3,587	$669	$510
Scientific and mechanical measuring instruments....	381-82	(D)	8.3	3.8	(D)	84	121
Optical, surgical, photographic, and other instruments......................................	383-87	7.3	11.6	6.5	2,762	455	310
Other manufacturing industries.......................	27,31,39	2.0	2.4	1.5	153	93	80

NOTE: Rankings were based on total (company, Federal, and other) R&D funds.

(D) Data have been withheld to avoid disclosing operations of individual companies.
(S) Data have been withheld due to imputation of more than 50 percent.

SOURCE: National Science Foundation, SRS

Table B-23. Company and other (except Federal) R&D funds as a percent of net sales in R&D-performing manufacturing companies ranked by size of company-financed R&D program, by industry: 1989

Industry	SIC code	Company and other R&D funds as a percent of net sales [Percent] First 4 companies	Next 4 companies	Next 12 companies	Company and other R&D funds [Dollars in millions] First 4 companies	Next 4 companies	Next 12 companies
Total..................................	....	7.1 %	7.8 %	5.9 %	$15,410	$4,784	$9,048
Food, kindred, and tobacco products..........	20,21	0.9	1.1	0.5	559	197	296
Textiles and apparel........................	22,23	(S)	0.3	0.4	(S)	35	39
Lumber, wood products, and furniture.........	24,25	1.4	0.8	0.7	89	23	32
Paper and allied products....................	26	1.1	1.1	0.7	310	120	138
Chemicals and allied products................	28	7.1	7.5	6.7	3,020	1,871	3,060
Industrial chemicals........................	281-82,286	6.0	2.8	3.5	2,550	553	624
Drugs and medicines.........................	283	12.3	9.1	9.1	2,134	1,191	1,674
Other chemicals.............................	284-85,287-89	5.0	2.8	2.0	1,085	217	233
Petroleum refining and extraction............	13,29	1.4	0.9	0.6	1,231	543	262
Rubber products..............................	30	3.6	1.8	1.8	423	69	96
Stone, clay, and glass products..............	32	4.4	1.8	1.0	654	104	68
Primary metals...............................	33	0.9	1.6	1.0	289	117	187
Ferrous metals and products................	331-32,3398-99	(D)	1.0	1.0	128	65	57
Nonferrous metals and products.............	333-36	1.9	1.6	0.7	278	82	78
Fabricated metal products....................	34	2.8	1.7	1.1	236	87	85
Machinery....................................	35	18.4	9.6	7.5	7,393	1,256	1,510
Office, computing, and accounting machines..................................	357	18.4	16.9	8.3	7,393	1,037	1,051
Other machinery, except electrical.........	351-56,358-59	4.9	4.7	3.3	853	224	313
Electrical equipment.........................	36	9.3	5.5	4.6	4,902	1,160	1,907
Radio and TV receiving equipment...........	365	3.4	(S)	(S)	62	(S)	(S)
Communication equipment....................	366	7.2	3.0	5.4	3,893	803	547
Electronic components......................	367	13.9	6.5	8.8	2,152	608	483
Other electrical equipment.................	361-64,369	5.0	2.0	1.8	373	171	218
Transportation equipment.....................	37	4.5	3.9	3.8	9,644	2,633	2,103
Motor vehicles and motor vehicles equipment.................................	371	4.5	(S)	0.7	8,432	117	111
Other transportation equipment..............	373-75,379	3.1	(S)	(S)	309	(S)	(S)
Aircraft and missiles.......................	372,376	4.0	5.5	2.1	3,388	1,636	859

See footnotes at end of

Table B-23. Company and other (except Federal) R&D funds as a percent of net sales in R&D-performing manufacturing companies ranked by size of company-financed R&D program, by industry: 1989 (continued)

Industry	SIC code	Company and other R&D funds as a percent of net sales [Percent]			Company and other R&D funds [Dollars in millions]		
		First 4 companies	Next 4 companies	Next 12 companies	First 4 companies	Next 4 companies	Next 12 companies
Professional and scientific instruments......	38	8.8 %	(S)	9.0 %	$3,500	(S)	$510
Scientific and mechanical measuring instruments................................	381-82	(D)	8.3	3.8	(D)	$84	121
Optical, surgical, photographic, and other instruments.........................	383-87	7.1	11.6	7.2	2,675	454	302
Other manufacturing industries...............	27,31,39	2.0	2.4	1.5	153	93	80

NOTE: Rankings were based on company and other (except Federal) R&D funds.

(S) Data have been withheld due to imputation of 50 percent or more.
(D) Data have been withheld to avoid disclosing operations of individual companies.

SOURCE: National Science Foundation, SRS

Table B-24. Federal R&D funds as a percent of net sales in R&D-performing manufacturing companies ranked by size of Federal R&D program, by industry: 1989

Industry	SIC code	Federal R&D funds as a percent of net sales [Percent]			Federal R&D funds [Dollars in millions]		
		First 4 companies	Next 4 companies	Next 12 companies	First 4 companies	Next 4 companies	Next 12 companies
Total..................................		17.7 %	3.4 %	5.2 %	$11,214	$4,908	$9,059
Food, kindred, and tobacco products..........	20,21	(D)	0.0	0.0	(D)	0	0
Textiles and apparel.........................	22,23	(D)	0.0	0.0	(D)	0	0
Lumber, wood products, and furniture.........	24,25	0.0	0.0	0.0	0	0	0
Paper and allied products....................	26	0.0	0.0	0.0	0	0	0
Chemicals and allied products................	28	1.3	0.1	0.0	64	13	8
Industrial chemicals.......................	281-82,286	1.3	0.1	0.0	64	13	6
Drugs and medicines........................	283	0.0	(D)	0.0	2	(D)	0
Other chemicals............................	284-85,287-89	(D)	0.0	0.0	(D)	0	0
Petroleum refining and extraction............	13,29	(S)	0.0	0.0	(S)	1	0
Rubber products..............................	30	(D)	0.0	0.0	(D)	0	0
Stone, clay, and glass products..............	32	(D)	0.0	0.0	(D)	0	0
Primary metals...............................	33	(D)	(S)	(D)	(D)	(S)	(D)
Ferrous metals and products................	331-32,3398-99	(S)	0.0	0.0	(S)	0	0
Nonferrous metals and products.............	333-36	(D)	(D)	0.0	(D)	(D)	0
Fabricated metal products....................	34	1.6	(D)	0.0	126	(D)	0
Machinery....................................	35	(D)	0.3	0.4	(D)	42	18
Office, computing, and accounting machines...................................	357	(D)	(D)	0.0	(D)	(D)	0
Other machinery, except electrical.........	351-56,358-59	0.8	0.4	0.2	93	9	2
Electrical equipment.........................	36	5.6	7.5	2.7	3,522	792	743
Radio and TV receiving equipment...........	365	0.0	0.0	0.0	0	0	0
Communication equipment....................	366	5.6	8.8	3.5	3,522	724	311
Electronic components......................	367	2.1	3.7	0.5	400	83	13
Other electrical equipment.................	361-64,369	0.6	(D)	0.0	23	(D)	0
Transportation equipment......................	37	17.7	(D)	5.1	11,214	4,894	5,514
Motor vehicles and motor vehicles equipment.................................	371	(D)	(D)	0.0	(D)	(D)	0
Other transportation equipment.............	373-75,379	1.0	0.0	0.0	67	0	0
Aircraft and missiles......................	372,376	17.7	11.4	7.4	11,241	4,720	3,678

See footnotes at end of

Table B-24. Federal R&D funds as a percent of net sales in R&D-performing manufacturing companies ranked by size of Federal R&D program, by industry: 1989 (continued)

Industry	SIC code	Federal R&D funds as a percent of net sales [Percent]			Federal R&D funds [Dollars in millions]		
		First 4 companies	Next 4 companies	Next 12 companies	First 4 companies	Next 4 companies	Next 12 companies
Professional and scientific instruments......	38	(D)	(S)	0.2 %	(D)	(S)	$3
Scientific and mechanical measuring instruments................................	381-82	(D)	0.0	0.0	(D)	$0	0
Optical, surgical, photographic, and other instruments.........................	383-87	(D)	0.0	(D)	(D)	6	(D)
Other manufacturing industries...............	27,31,39	(D)	0.0	0.0	(D)	0	0

Note: Rankings were based upon Federal R&D funds.

(D) Data have been withheld to avoid disclosing operations of individual companies.
(S) Data have been withheld due to imputation of 50 percent or more.

SOURCE: National Science Foundation, SRS

Table B-25. Total (company, Federal, and other) funds for basic research, applied research, and development performance, in current and in 1982 constant dollars: 1953-89

[Dollars in millions]

Year	Total		Basic research		Applied research		Development	
	current dollars	constant dollars	current dollars	constant dollars	current dollars	constant dollars	current dollars	constant dollars
1953 (1)	$3,630	$14,021	$151	$583	$726	$2,804	$2,753	$10,633
1954 (1)	4,070	15,475	166	631	814	3,095	3,090	11,749
1955 (1)	4,640	17,090	189	696	928	3,418	3,523	12,976
1956	6,605	23,530	253	901	1,268	4,517	5,084	18,112
1957	7,731	26,585	271	932	1,670	5,743	5,790	19,911
1958	8,389	28,274	295	994	1,911	6,441	6,183	20,839
1959	9,618	31,597	320	1,051	1,991	6,541	7,307	24,005
1960	10,509	33,955	376	1,215	2,029	6,556	8,104	26,184
1961	10,908	34,917	395	1,264	1,977	6,328	8,537	27,327
1962	11,464	35,892	488	1,528	2,449	7,668	8,527	26,697
1963	12,630	38,981	522	1,611	2,457	7,583	9,651	29,787
1964	13,512	41,032	549	1,667	2,600	7,896	10,363	31,470
1965	14,185	41,992	592	1,753	2,658	7,869	10,935	32,371
1966	15,548	44,474	624	1,7[illegible]	2,843	8,132	12,081	34,557
1967	16,385	45,590	629	1,750	2,915	8,111	12,841	35,729
1968	17,429	46,194	642	1,702	3,124	8,280	13,663	36,213
1969	18,308	46,023	618	1,554	3,287	8,263	14,403	36,207
1970	18,067	42,986	602	1,432	3,427	8,154	14,038	33,400
1971	18,320	41,280	590	1,329	3,415	7,695	14,315	32,256
1972	19,552	42,056	593	1,276	3,514	7,559	15,445	33,222
1973	21,249	42,893	631	1,274	3,825	7,721	16,793	33,898
1974	22,887	42,415	699	1,295	4,288	7,947	17,900	33,173
1975	24,187	40,781	730	1,231	4,570	7,705	18,887	31,845
1976	26,997	42,805	819	1,299	5,112	8,105	21,066	33,401
1977	29,825	44,330	911	1,354	5,636	8,377	23,278	34,599
1978 (1)	33,304	46,115	1,035	1,433	6,300	8,723	25,969	35,958
1979	38,226	48,652	1,158	1,474	7,225	9,196	29,843	37,983
1980 (1)	44,505	51,919	1,325	1,546	8,450	9,858	34,730	40,516
1981	51,810	55,140	1,614	1,718	10,699	11,387	39,497	42,036
1982 (1)	58,650	58,650	1,904	1,904	12,323	12,323	44,423	44,423
1983	65,268	62,842	2,223	2,140	13,927	13,409	49,118	47,293
1984	74,800	69,433	2,608	2,421	15,765	14,634	56,427	52,378
1985	84,239	75,925	2,862	2,580	18,255	16,453	63,122	56,892
1986	87,823	77,160	4,047	3,556	19,759	17,360	64,031	56,256
1987	92,155	78,477	4,324	3,682	19,813	16,872	68,016	57,920
1988	97,889	80,680	4,243	3,497	20,757	17,108	72,889	60,075
1989	101,599	80,436	4,000	3,167	23,086	18,277	74,513	58,992

(1) Character-of-work estimates were made by the National Science Foundation. See: National Science Foundation, National Patterns of R&D Resources: 1990, Final Report, NSF 90-316.

NOTES: The character-of-work estimation procedure was revised for 1986 and later years; hence, these data are not directly comparable with data for 1985 and earlier years. See technical notes for a more complete discussion of this change.

The 1982 GNP implicit price deflator was used to convert current dollars to constant dollars.

SOURCE: National Science Foundation, SRS.

Table B26: Funds for basic research, applied research, and development, by industry, by source of funds: 1987

[Dollars in millions]

		Total			Basic			Applied			Development		
Distribution by industry	SIC code	Total	Federal	Company	Total	Federal	Company	Total	Federal	Company	Total	Federal	Company
Total		$92,155	$30,752	$61,403	$4,324	$740	$3,583	$19,813	$4,660	$15,153	$68,016	$25,350	$42,666
Food, kindred, and tobacco products	20,21	1,206	2	1,204	65	0	65	(D)	(D)	419	720	0	720
Textiles and apparel	22,23	(D)	(D)	243	(D)	0	(D)	11	0	11	(D)	(D)	200
Lumber, wood products, and furniture	24,25	137	0	137	23	0	23	38	0	(S)	76	0	76
Paper and allied products	26	(D)	(D)	604	45	0	45	223	0	223	(D)	(D)	336
Chemicals and allied products	28	9,635	190	9,445	700	12	688	3,691	105	3,586	5,242	70	5,171
Industrial chemicals	281-82,286	3,716	185	3,531	(D)	(D)	291	1,397	105	1,291	(D)	(D)	1,949
Drugs and medicines	283	(D)	(D)	4,095	360	0	360	1,568	0	1,568	(D)	(D)	2,167
Other chemicals	284-85,287-89	(D)	(D)	1,819	(D)	(D)	36	727	0	727	1,056	0	1,056
Petroleum refining and extraction	13,29	1,897	14	1,883	(D)	(D)	103	(D)	(D)	910	879	9	870
Rubber products	30	(D)	(D)	596	32	0	(S)	(D)	(D)	(D)	454	(D)	(D)
Stone, clay, and glass products	32	995	10	985	(D)	(D)	165	(D)	(D)	(S)	(D)	(D)	374
Primary metals	33	730	19	711	(D)	(D)	70	(D)	(D)	253	399	11	388
Ferrous metals and products	331-32,3398-99	(D)	(D)	249	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	113
Nonferrous metals and products	333-36	(D)	(D)	462	66	0	(D)	128	(D)	(D)	(D)	(D)	275
Fabricated metal products	34	783	150	633	49	0	(S)	(D)	(D)	126	(D)	(D)	458
Machinery	35	(D)	(D)	10,577	(D)	(D)	280	(D)	(D)	1,782	(D)	(D)	8,515
Office, computing, and accounting machines	357	(D)	(D)	8,193	(D)	(D)	154	(D)	(D)	1,328	(D)	(D)	6,711
Other machinery, except electrical	351-56,358-59	2,428	44	2,384	(S)	0	(S)	(D)	(D)	454	(D)	(D)	1,804
Electrical equipment	36	15,848	5,399	10,449	917	(D)	(D)	3,725	(D)	(D)	11,206	4,252	6,954
Radio and TV receiving equipment	365	139	0	139	(D)	0	(D)	(D)	0	(D)	63	0	(S)
Communication equipment	366	10,184	4,729	5,455	(D)	(D)	(D)	(D)	(D)	(D)	8,361	3,963	4,398
Electronic components	367	4,286	656	3,630	(D)	(D)	(S)	(D)	(D)	(S)	(D)	(D)	(D)
Other electrical equipment	361-64,369	1,239	14	1,225	122	0	(S)	(D)	(D)	204	(D)	(D)	(D)
Transportation equipment	37	34,246	20,784	13,462	522	(D)	(D)	3,928	(D)	(D)	29,796	18,578	11,218
Motor vehicles and motor vehicles equipment	371	(D)	(D)	7,167	(D)	(D)	93	(D)	(D)	(D)	(D)	(D)	6,471
Other transportation equipment	373-75,379	(D)	(D)	356	(D)	0	(D)	(D)	(D)	(D)	(D)	(D)	130
Aircraft and missiles	372,376	24,458	18,519	5,939	425	335	90	2,941	(D)	1,232	21,091	16,475	4,617

See footnotes at end of

Table B26: Funds for basic research, applied research, and development, by industry, by source of funds: 1987 (continued)

[Dollars in millions]

Distribution by industry	SIC code	Total Total	Total Federal	Total Company	Basic Total	Basic Federal	Basic Company	Applied Total	Applied Federal	Applied Company	Development Total	Development Federal	Development Company
Professional and scientific instruments...........	38	$5,222	$272	$4,950	(D)	(D)	$564	(D)	(D)	(S)	(S)	(S)	(S)
Scientific and mechanical measuring instruments.	381-82	(D)	(D)	1,598	$170	$0	170	(D)	(D)	(S)	(D)	(D)	$1,161
Optical, surgical, photographic, and other instruments.....................................	383-87	(D)	(D)	3,352	(D)	(D)	(S)	(D)	(D)	(S)	(D)	(D)	(S)
Other manufacturing industries.....................	27,31,39	(D)	(D)	380	(S)	0	(S)	$38	$0	$38	$316	$0	316
Nonmanufacturing industries.........................	10-11,14-17,40-42,44-51,53-54,56,60,62-63,72-73,78,806-07,87	7,844	2,700	5,144	706	295	(S)	2,548	1,139	(S)	4,590	1,266	(S)

(D) Data have been withheld to avoid disclosing operations of individual companies.
(S) Data have been withheld due to imputation of more than 50 percent.

NOTE: The character-of-work estimation procedure was revised for 1986 and later years; hence, these data are not directly comparable with data for 1985 and earlier years. See technical notes for a more complete discussion of this change.

SOURCE: National Science Foundation, SRS

Table B27: Funds for basic research, applied research, and development, by industry, by source of funds: 1988

[Dollars in millions]

Distribution by industry	SIC code	Total			Basic			Applied			Development		
		Total	Federal	Company	Total	Federal	Company	Total	Federal	Company	Total	Federal	Company
Total		$97,889	$32,306	$65,583	$4,243	$891	$3,353	$20,757	$4,558	$16,199	$72,889	$26,857	$46,032
Food, kindred, and tobacco products	20,21	(D)	(D)	1,192	51	0	51	428	0	428	(D)	(D)	713
Textiles and apparel	22,23	(D)	(D)	210	(D)	0	(D)	(D)	0	(D)	(D)	(D)	176
Lumber, wood products, and furniture	24,25	(D)	(D)	156	(D)	0	(D)	(D)	0	(D)	(D)	(D)	89
Paper and allied products	26	(D)	(D)	664	52	0	52	(D)	(D)	234	378	0	378
Chemicals and allied products	28	10,772	199	10,573	829	12	817	4,378	109	4,269	5,565	78	5,487
Industrial chemicals	281-82,286	3,959	196	3,763	302	12	290	(D)	(D)	1,459	(D)	(D)	2,014
Drugs and medicines	283	4,746	3	4,743	(S)	0	(S)	(D)	(D)	1,947	(D)	(D)	2,320
Other chemicals	284-85,287-89	2,067	0	2,067	51	0	51	863	0	863	1,152	0	1,152
Petroleum refining and extraction	13,29	1,944	21	1,923	(D)	(D)	97	(D)	(D)	994	845	13	832
Rubber products	30	(D)	(D)	635	58	0	58	(D)	(D)	130	(D)	(D)	447
Stone, clay, and glass products	32	(D)	(D)	826	163	0	163	(D)	(D)	(S)	231	1	230
Primary metals	33	663	21	642	69	0	69	(D)	(D)	231	(D)	(D)	342
Ferrous metals and products	331-32,3398-99	258	1	257	4	0	4	(D)	(D)	127	(D)	(D)	127
Nonferrous metals and products	333-36	405	20	385	65	0	65	(D)	(D)	104	(D)	(D)	216
Fabricated metal products	34	829	142	687	56	0	56	(D)	(D)	152	(D)	(D)	479
Machinery	35	(D)	(D)	11,992	(D)	(D)	260	(D)	(D)	2,061	(D)	(D)	9,671
Office, computing, and accounting machines	357	(D)	(D)	9,371	(D)	(D)	164	(D)	(D)	1,584	(D)	(D)	7,624
Other machinery, except electrical	351-56,358-59	2,719	98	2,621	96	0	96	(D)	(D)	478	(D)	(D)	2,047
Electrical equipment	36	16,242	5,369	10,873	610	26	584	3,804	1,026	2,778	11,828	4,317	7,512
Radio and TV receiving equipment	365	139	0	139	(D)	0	(D)	(D)	0	(D)	(D)	0	(D)
Communication equipment	366	10,296	4,621	5,675	(D)	25	(D)	1,426	(D)	(D)	8,577	(D)	(D)
Electronic components	367	4,607	728	3,879	(D)	(D)	(S)	(D)	(D)	1,731	(D)	(D)	2,004
Other electrical equipment	361-64,369	1,200	20	1,180	119	0	(S)	208	0	208	873	20	853
Transportation equipment	37	36,338	22,176	14,162	472	263	209	3,920	2,061	1,859	31,946	19,852	12,094
Motor vehicles and motor vehicles equipment	371	(D)	(D)	7,769	(D)	0	(D)	(D)	(D)	(D)	(D)	(D)	(D)
Other transportation equipment	373-75,379	(D)	(D)	370	(D)	0	(D)	(D)	(D)	(D)	(D)	(D)	(D)
Aircraft and missiles	372,376	25,900	19,877	6,023	366	263	103	2,994	1,915	1,079	22,540	17,700	4,840

See footnotes at end of

Table B27: Funds for basic research, applied research, and development, by industry, by source of funds: 1988 (continued)

[Dollars in millions]

Distribution by industry	SIC code	Total Total	 Federal	 Company	Basic Total	 Federal	 Company	Applied Total	 Federal	 Company	Development Total	 Federal	 Company
Professional and scientific instruments...........	38	$5,426	$120	$5,306	(D)	(D)	$487	(D)	(D)	$1,139	$3,771	$91	$3,680
Scientific and mechanical measuring instruments.	381-82	1,734	(S)	1,710	$165	$0	165	(D)	(D)	276	(D)	(D)	1,269
Optical, surgical, photographic, and other instruments....................................	383-87	3,692	96	3,596	(D)	(D)	323	(D)	(D)	863	(D)	(D)	2,411
Other manufacturing industries....................	27,31,39	(D)	(D)	383	0	0	0	$49	$0	49	334	0	334
Nonmanufacturing industries.......................	10-11,14-17,40-42,44-51,53-54,56,60,62-63,72-73,78,806-07,87	8,113	2,753	5,360	980	577	403	2,208	821	1,387	4,926	1,356	3,570

(D) Data have been withheld to avoid disclosing operations of individual companies.
(S) Data have been withheld due to imputation of more than 50 percent.

NOTE: The character-of-work estimation procedure was revised for 1986 and later years; hence, these data are not directly comparable with data for 1985 and earlier years. See technical notes for a more complete discussion of this change.

SOURCE: National Science Foundation, SRS

Table B28: Funds for basic research, applied research, and development, by industry, by source of funds: 1989

[Dollars in millions]

Distribution by industry	SIC code	Total			Basic			Applied			Development		
		Total	Federal	Company	Total	Federal	Company	Total	Federal	Company	Total	Federal	Company
Total		$101,599	$31,366	$70,233	$4,000	$1,095	$2,905	$23,086	$4,825	$18,261	$74,513	$25,447	$49,066
Food, kindred, and tobacco products	20,21	(D)	(D)	(S)	24	0	24	(D)	(D)	468	(D)	(D)	791
Textiles and apparel	22,23	(D)	(D)	212	(D)	(D)	(D)	(S)	0	(S)	(D)	(D)	(S)
Lumber, wood products, and furniture	24,25	170	0	170	(D)	0	(D)	53	0	53	93	0	93
Paper and allied products	26	683	0	683	42	0	42	175	0	175	466	0	466
Chemicals and allied products	28	11,537	87	11,450	797	9	789	4,820	19	4,802	5,920	61	5,859
Industrial chemicals	281-82,286	4,056	84	3,972	322	9	314	1,584	(S)	1,568	2,150	60	2,091
Drugs and medicines	283	(D)	(D)	5,206	(S)	0	(S)	(D)	(D)	2,186	(D)	(D)	2,585
Other chemicals	284-85,287-89	(D)	(D)	2,271	40	0	40	(D)	(D)	1,047	(D)	(D)	1,184
Petroleum refining and extraction	13,29	2,066	(S)	2,050	(D)	(D)	106	(D)	(D)	988	965	10	956
Rubber products	30	(D)	(D)	679	40	0	40	191	1	190	(D)	(D)	449
Stone, clay, and glass products	32	(D)	(D)	861	(D)	(D)	181	(D)	(D)	419	(D)	(D)	261
Primary metals	33	768	34	734	(S)	0	(S)	(D)	(D)	262	416	20	396
Ferrous metals and products	331-32,3398-99	(D)	(D)	270	(D)	0	(D)	(D)	(D)	134	(D)	(D)	131
Nonferrous metals and products	333-36	(D)	(D)	463	(D)	0	(D)	(D)	(D)	128	(D)	(D)	265
Fabricated metal products	34	788	135	653	35	0	35	(D)	(D)	(S)	569	115	454
Machinery	35	(D)	(D)	13,216	(D)	(D)	(S)	(D)	(D)	3,069	(D)	(D)	(S)
Office, computing, and accounting machines	357	(D)	(D)	10,533	(D)	(D)	(S)	(D)	(D)	2,473	(D)	(D)	(S)
Other machinery, except electrical	351-56,358-59	2,789	106	2,683	59	0	59	(D)	(D)	595	2,106	77	2,029
Electrical equipment	36	16,768	5,222	11,546	462	13	449	3,786	741	3,045	12,521	4,469	8,052
Radio and TV receiving equipment	365	85	0	85	(S)	0	(S)	(D)	0	(D)	(D)	0	(D)
Communication equipment	366	10,508	4,666	5,842	(D)	(D)	(D)	(D)	(D)	(D)	8,821	4,081	4,740
Electronic components	367	4,884	522	4,362	(D)	(D)	54	(D)	(D)	1,924	(D)	(D)	2,384
Other electrical equipment	361-64,369	1,292	35	1,257	(D)	0	(D)	295	0	295	(D)	(D)	(D)
Transportation equipment	37	36,863	21,763	15,100	675	493	182	4,370	2,461	1,910	31,818	18,810	13,008
Motor vehicles and motor vehicles equipment	371	(D)	(D)	8,726	(D)	0	(D)	(D)	(D)	(D)	(D)	(D)	(D)
Other transportation equipment	373-75,379	(D)	(D)	354	(D)	0	(D)	(D)	(D)	(D)	(D)	(D)	(D)
Aircraft and missiles	372,376	25,654	19,634	6,020	582	493	90	3,322	2,311	1,012	21,749	16,831	4,919

See footnotes at end of

Table B28: Funds for basic research, applied research, and development, by industry, by source of funds: 1989 (continued)

[Dollars in millions]

Distribution by industry	SIC code	Total			Basic			Applied			Development		
		Total	Federal	Company	Total	Federal	Company	Total	Federal	Company	Total	Federal	Company
Professional and scientific instruments	38	$5,763	$125	$5,638	(D)	(D)	$364	(D)	(D)	(S)	(S)	(S)	(S)
Scientific and mechanical measuring instruments.	381-82	(D)	(D)	1,858	$86	$0	86	(D)	(D)	(S)	(D)	(D)	$1,394
Optical, surgical, photographic, and other instruments	383-87	(D)	(D)	3,780	(D)	(D)	(S)	(D)	(D)	(S)	(D)	(D)	(S)
Other manufacturing industries	27,31,39	(D)	(D)	402	(S)	0	(S)	$63	$0	$63	$306	$1	305
Nonmanufacturing industries	10-11,14-17,40-42,44-51,53-54,56,60,62-63,72-73,78,806-07,87	8,273	2,716	5,557	862	561	(S)	2,243	925	(S)	5,169	1,230	(S)

(D) Data have been withheld to avoid disclosing operations of individual companies.
(S) Data have been withheld due to imputation of more than 50 percent.

NOTE: The character-of-work estimation procedure was revised for 1986 and later years; hence, these data are not directly comparable with data for 1985 and earlier years. See technical notes for a more complete discussion of this change.

SOURCE: National Science Foundation, SRS

Table B-29. Number of R&D-performing companies conducting basic research, by industry, by size of company: 1989

Industry	SIC code	Less than 500 employees		500 to 999 employees		1,000 to 4,999 employees		5,000 to 9,999 employees		10,000 to 24,999 employees		25,000 or more employees	
		R&D	Basic research	R&D	Basic research	R&D	Basic research	R&D	Basic research	R&D	Basic research	R&D	Basic research
Total	....	22,486	130	761	38	1,043	109	187	29	175	55	123	34
Food, kindred, and tobacco products	20,21	8	0	35	1	48	3	14	3	13	3	15	4
Textiles and apparel	22,23	286	1	106	0	44	0	8	2	9	1	4	1
Lumber, wood products, and furniture	24,25	78	1	27	1	37	2	7	0	4	1	1	0
Paper and allied products	26	261	0	13	2	32	3	9	0	8	1	3	0
Chemicals and allied products	28	2,325	4	39	8	68	24	9	3	21	10	9	3
Industrial chemicals	281-82,286	204	1	11	2	23	10	6	2	4	2	5	3
Drugs and medicines	283	407	1	6	1	12	5	1	1	10	6	3	0
Other chemicals	284-85,287-89	1,714	2	22	5	33	9	2	0	7	2	1	0
Petroleum refining	29	104	0	3	0	11	2	5	1	4	4	7	4
Rubber products	30	308	1	35	2	133	2	5	1	6	2	1	0
Stone, clay, and glass products	32	86	0	26	0	29	4	6	2	6	5	2	1
Primary metals	33	169	1	23	0	41	4	10	2	7	2	3	2
Ferrous metals and products	331-32,3398-99	80	0	10	0	20	2	7	0	3	0	2	1
Nonferrous metals and products	333-36	89	1	13	0	21	2	3	2	4	2	1	1
Fabricated metal products	34	1,907	1	57	1	60	3	10	2	7	1	0	0
Machinery	35	2,535	16	98	5	124	9	26	2	11	2	7	1
Office, computing, and accounting machines	357	431	7	24	2	28	1	11	0	3	1	4	1
Other machinery, except electrical	351-56,358-59	2,104	9	74	3	96	8	15	2	8	1	3	0
Electrical equipment	36	3,424	19	104	6	114	15	15	3	15	2	15	4
Radio and TV receiving equipment	365	172	1	3	0	3	2	1	0	0	0	0	0
Communication equipment	366	613	4	15	1	20	5	4	0	4	0	9	2
Electronic components	367	1,267	14	35	1	38	2	4	1	5	1	2	1
Other electrical equipment	361-64,369	1,372	0	51	4	53	6	6	2	6	1	4	1
Transportation equipment	37	150	0	32	2	45	7	9	3	16	5	18	8
Motor vehicles and motor vehicles equipment	371	100	0	19	1	25	3	5	2	6	1	4	1
Other transportation equipment	373-75,379	49	0	6	0	9	2	0	0	4	1	0	0
Aircraft and missiles	372,376	1	0	7	1	11	2	4	1	6	3	14	7

See footnotes at end of

Table B-29. Number of R&D-performing companies conducting basic research, by industry, by size of company: 1989 (continued)

Industry		Size of Company											
		Less than 500 employees		500 to 999 employees		1,000 to 4,999 employees		5,000 to 9,999 employees		10,000 to 24,999 employees		25,000 or more employees	
		R&D	Basic research	R&D	Basic research	R&D	Basic research	R&D	Basic research	R&D	Basic research	R&D	Basic research
Professional and scientific instruments....	38	1,808	17	38	2	44	6	10	2	3	2	4	1
Scientific and mechanical measuring instruments...............................	381-82	979	10	15	0	18	2	5	0	1	0	0	0
Optical, surgical, photographic, and other instruments..............................	383-87	829	7	23	2	26	4	5	2	2	2	4	1
Other manufacturing industries.............	27,31,39	310	0	36	2	38	4	7	1	7	2	0	0
Nonmanufacturing industries................	10-11,14-17,40-42,44-51,53-54,56,60,62-63,72-73,78,806-07,87	8,727	69	89	6	175	21	37	2	38	12	34	5

SOURCE: National Science Foundation, SRS.

Table B-30. Funds for industrial applied R&D performance, by product field, by source of funds: 1989

[Dollars in millions]

Product field	SIC Code	Total	Federal	Company
Total		$51,150	$13,604	$37,546
Food and kindred products	20	519	0	519
Textile mill products	22	83	(D)	(D)
Chemicals, except drugs and medicines	28, except 283	5,917	69	5,848
Industrial inorganic and organic chemicals	281,286	787	30	757
Plastics materials and synthetic resins, rubber, and fibers	282	1,051	(D)	(D)
Drugs and medicines	283	2,680	14	2,666
Agricultural chemicals	287	561	0	561
Other chemicals	284-85,289	838	(D)	(D)
Petroleum refining	29	621	35	586
Rubber and miscellaneous plastics products	30	449	(D)	(D)
Stone, clay, and glass products	32	173	5	168
Primary metals	33	232	9	223
Ferrous metals and products	331-32,3398-99	171	(D)	(D)
Nonferrous metals and products	333-36	61	(D)	(D)
Fabricated metal products	34	1,371	947	424
Ordnance and accessories, n.e.c	348	304	230	74
Other fabricated metal products	341-47,349	1,067	717	350
Machinery	35	8,548	164	8,384
Engines and turbines	351	834	113	721
Farm machinery and equipment	352	177	0	177
Construction, mining, and materials handling machinery	353	370	(D)	(D)
Metalworking machinery and equipment	354	119	(D)	(D)
Office, computing, and accounting machines	357	6,804	4	6,800
Other machinery, except electrical	355-56,358-59	244	31	213
Electrical equipment	36	10,495	2,551	7,944
Electric transmission and distribution equipment	361,3825	168	70	98
Electrical industrial apparatus	362	150	40	110
Radio and TV receiving equipment	365	106	(D)	(D)
Communication equipment	366	5,709	1,495	4,214
Electronic components	367	3,865	896	2,969
Other electrical equipment and supplies	363-64,368-69	497	(D)	(D)
Transportation equipment	37	13,116	5,830	7,286
Motor vehicles and equipment	371	(D)	66	(D)
Other transportation equipment	373-75,379	(D)	22	(D)
Aircraft and parts	372	5,839	3,629	2,210
Guided missiles and spacecraft	376	2,338	2,113	225
Professional and scientific instruments	38, except 3825	1,077	222	855
Scientific and mechanical measuring instruments	381-82	647	(D)	(D)
Optical, surgical, photographic, and other instruments	383-87	430	(D)	(D)
Other product fields, n.e.c	-	8,550	3,769	4,781

n.e.c. Not elsewhere classified.

(D) Data have been withheld to avoid disclosing operations of individual companies.

NOTE: Imputation of R&D expenditures by product field was eliminated beginning in 1985. This table, therefore, contains only data reported by survey respondents. See table B-31 for coverage ratios showing the percentage of each industry's applied research and development funds that respondents distributed by product field.

SOURCE: National Science Foundation, SRS

Table B-31. Total (company, Federal, and other) funds for industrial applied R&D performance, by industry, by product field: 1989

[Dollars in millions]

Industry	SIC Code	Total	Coverage ratio	Food and kindred products 20	Textile mill products 22	Chemicals 28	Petroleum refining 29	Rubber products 30
Total		$72,911	0.70	$519	$83	$5,917	$621	$449
Food, kindred, and tobacco products	20,21	993	0.58	400	(D)	28	0	0
Textiles and apparel	22,23	(S)	0.45	0	55	(D)	0	(D)
Lumber, wood products, and furniture	24,25	107	0.59	0	0	(D)	0	(D)
Paper and allied products	26	444	0.73	(D)	(D)	19	0	(D)
Chemicals and allied products	28	7,468	0.74	106	(D)	4,390	(D)	(D)
Industrial chemicals	281-82,286	2,626	0.68	13	(D)	1,334	(D)	(D)
Drugs and medicines	283	3,010	0.70	(D)	0	1,878	0	(D)
Other chemicals	284-85,287-89	1,832	0.91	(D)	0	1,178	(D)	(D)
Petroleum refining and extraction	13,29	1,326	0.99	(D)	0	438	508	(D)
Rubber products	30	283	0.68	0	0	58	0	95
Stone, clay, and glass products	32	661	0.35	0	(D)	(D)	0	(D)
Primary metals	33	554	0.52	0	0	(D)	(D)	(D)
Ferrous metals and products	331-32,3398-99	165	0.70	0	0	0	(D)	(D)
Nonferrous metals and products	333-36	389	0.45	0	0	(D)	0	0
Fabricated metal products	34	498	0.52	(D)	(D)	(D)	0	4
Machinery	35	(S)	0.90	(D)	(D)	21	(D)	6
Office, computing, and accounting machines	357	(S)	0.96	0	0	(D)	0	0
Other machinery, except electrical	351-56,358-59	2,238	0.63	(D)	(D)	(D)	(D)	6
Electrical equipment	36	12,895	0.63	0	(D)	7	0	9
Radio and TV receiving equipment	365	(D)	0.10	0	0	0	0	0
Communication equipment	366	8,502	0.73	0	0	(D)	0	0
Electronic components	367	3,495	0.45	0	0	(D)	0	0
Other electrical equipment	361-64,369	(D)	0.38	0	(D)	2	0	9
Transportation equipment	37	25,604	0.69	0	14	322	(D)	(D)
Motor vehicles and motor vehicles equipment	371	(D)	0.99	0	(D)	(D)	(D)	(D)
Other transportation equipment	373-75,379	(D)	0.77	0	(D)	(D)	(D)	(D)
Aircraft and missiles	372,376	18,144	0.56	0	(D)	(D)	(D)	4

See footnotes at end of

Table B-31. Total (company, Federal, and other) funds for industrial applied R&D performance, by industry, by product field: 1989 (continued)

[Dollars in millions]

Industry	SIC Code	Total	Coverage ratio	Food and kindred products 20	Textile mill products 22	Chemicals 28	Petroleum refining 29	Rubber products 30
Professional and scientific instruments....	38	2,761	0.27	(D)	(D)	$50	(D)	(D)
Scientific and mechanical measuring instruments............................	381-82	503	0.62	(D)	(D)	(D)	(D)	(D)
Optical, surgical, photographic, and other instruments............................	383-87	2,258	0.19	$0	$0	(D)	$0	(D)
Other manufacturing industries............	27,31,39	300	0.50	0	0	(D)	0	(D)
Nonmanufacturing industries...............	10-11,14-17,40-42,44-51,53-54,56,60,62-63,72-73,78,806-07,87	6,228	0.65	(D)	(D)	418	37	(1)

Industry	SIC Code	Stone, clay, and glass products 32	Primary metals 33	Fabricated metal products 34	Machinery 35	Electrical equipment 36	Transportation equipment 37	Professional and scientific instruments 38	Other product fields n.e.c. ...
Total...		$173	$232	$1,371	$8,548	$10,495	$13,116	$1,077	$8,550
Food, kindred, and tobacco products........	20,21	(D)	(D)	(D)	6	(D)	0	0	129
Textiles and apparel.......................	22,23	0	0	(D)	(D)	1	(D)	0	2
Lumber, wood products, and furniture.......	24,25	(D)	0	(D)	(D)	0	0	(D)	42
Paper and allied products..................	26	0	0	(D)	18	(D)	(D)	(D)	270
Chemicals and allied products..............	28	15	9	36	(D)	(D)	(D)	219	531
Industrial chemicals.....................	281-82,286	(D)	(D)	(D)	(D)	(D)	0	(D)	(D)
Drugs and medicines......................	283	(D)	(D)	(D)	(D)	(D)	0	95	(D)
Other chemicals..........................	284-85,287-89	(D)	(D)	(D)	0	3	(D)	(D)	384
Petroleum refining and extraction..........	13,29	(D)	(D)	0	(D)	(D)	(D)	2	285
Rubber products............................	30	0	(D)	(D)	(D)	(D)	(D)	(D)	12
Stone, clay, and glass products............	32	107	0	(D)	(D)	(D)	29	(D)	(D)
Primary metals.............................	33	0	109	24	(D)	74	5	(D)	(D)
Ferrous metals and products..............	331-32,3398-99	0	84	9	(D)	(D)	(D)	0	0
Nonferrous metals and products...........	333-36	0	25	15	(D)	(D)	(D)	(D)	(D)

See footnotes at end of

Table B-31. Total (company, Federal, and other) funds for industrial applied R&D performance, by industry, by product field: 1989 (continued)

[Dollars in millions]

Industry	SIC Code	Stone, clay, and glass products 32	Primary metals 33	Fabricated metal products 34	Machinery 35	Electrical equipment 36	Transportation equipment 37	Professional and scientific instruments 38	Other product fields n.e.c. ...
Fabricated metal products	34	$0	(D)	$81	$7	$17	$13	(D)	$80
Machinery	35	(D)	(D)	70	7,194	(D)	43	$14	1,788
Office, computing, and accounting machines	357	0	$0	0	6,196	(D)	0	(D)	1,618
Other machinery, except electrical	351-56,358-59	(D)	(D)	70	998	58	43	(D)	170
Electrical equipment	36	(D)	(D)	(D)	310	5,017	105	109	1,944
Radio and TV receiving equipment	365	0	0	0	0	(D)	0	0	0
Communication equipment	366	0	(D)	(D)	236	3,466	78	39	(D)
Electronic components	367	0	0	3	65	1,429	(D)	26	35
Other electrical equipment	361-64,369	(D)	(D)	(D)	9	(D)	(D)	44	(D)
Transportation equipment	37	(D)	83	410	548	1,987	12,430	160	1,669
Motor vehicles and motor vehicles equipment	371	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
Other transportation equipment	373-75,379	0	(D)	(D)	(D)	(D)	(D)	0	(D)
Aircraft and missiles	372,376	(D)	19	(D)	188	1,318	7,002	(D)	1,191
Professional and scientific instruments	38	(D)	(D)	(D)	37	175	4	405	59
Scientific and mechanical measuring instruments	381-82	(D)	(D)	(D)	(D)	136	(D)	116	35
Optical, surgical, photographic, and other instruments	383-87	(D)	0	(D)	(D)	39	(D)	289	24
Other manufacturing industries	27,31,39	0	(D)	0	(D)	(D)	0	(D)	105
Nonmanufacturing industries	10-11,14-17,40-42,44-51,53-54,56,60,62-63,72-73,78,806-07,87	20	9	(D)	395	775	463	139	1,622

n.e.c. Not elsewhere classified

(D) Data have been withheld to avoid disclosing operations of individual companies.
(S) Data have been withheld due to imputation of 50 percent or more.
(1) Less than $0.5 million.

NOTE: Imputation of R&D expenditures by product field was eliminated beginning in 1985. Coverage ratios show the percentage of each industry's applied research and development funds that respondents distributed by product field.

SOURCE: National Science Foundation, SRS

Table B-32. Total (company, Federal, and other) funds for industrial applied R&D performance, by industry, by secondary product field: 1989

[Dollars in millions]

Industry	SIC Code	Chemicals				
		Industrial inorganic and organic chemicals 281,286	Plastics, synthetic resins, rubber, and fibers 282	Drugs and medicines 283	Agricultural chemicals 287	Other chemicals 284-85, 289
Total...		$787	$1,051	$2,680	$561	$838
Food, kindred, and tobacco products........	20,21	1	21	(D)	1	(D)
Textiles and apparel.......................	22,23	0	0	0	0	(D)
Lumber, wood products, and furniture.......	24,25	0	(D)	0	0	0
Paper and allied products..................	26	(D)	(D)	0	0	(D)
Chemicals and allied products..............	28	498	573	2,323	414	580
Industrial chemicals.....................	281-82,286	328	(D)	(D)	182	107
Drugs and medicines......................	283	50	(D)	1,694	(D)	30
Other chemicals..........................	284-85,287-89	120	40	(D)	(D)	442
Petroleum refining and extraction..........	13,29	114	173	(D)	(D)	122
Rubber products............................	30	(D)	45	0	0	(D)
Stone, clay, and glass products............	32	(D)	(D)	0	(D)	(D)
Primary metals.............................	33	(D)	(D)	(D)	(D)	(D)
Ferrous metals and products..............	331-32,3398-99	0	0	0	0	0
Nonferrous metals and products...........	333-36	(D)	(D)	(D)	(D)	(D)
Fabricated metal products..................	34	(D)	(D)	0	0	0
Machinery..................................	35	1	(D)	0	0	(D)
Office, computing, and accounting machines................................	357	0	(D)	0	0	(D)
Other machinery, except electrical.......	351-56,358-59	1	8	0	0	(D)
Electrical equipment..............	36	4	1	0	0	(D)
Radio and TV receiving equipment.........	365	0	0	0	0	0
Communication equipment..................	366	(D)	(D)	0	0	0
Electronic components....................	367	(D)	(D)	0	0	0
Other electrical equipment...............	361-64,369	(D)	(D)	0	0	(D)
Transportation equipment...................	37	41	(D)	(D)	(D)	(D)
Motor vehicles and motor vehicles equipment..............................	371	(D)	(D)	0	0	(D)
Other transportation equipment...........	373-75,379	(D)	(D)	(D)	(D)	(D)
Aircraft and missiles....................	372,376	(D)	(D)	0	(D)	(D)
Professional and scientific instruments....	38	(D)	(D)	32	(D)	3
Scientific and mechanical measuring instruments..............................	381-82	(D)	(D)	(D)	(D)	(D)
Optical, surgical, photographic, and other instruments..............................	383-87	(D)	(D)	(D)	0	(D)
Other manufacturing industries.............	27,31,39	(D)	(D)	0	0	(D)
Nonmanufacturing industries................	10-11,14-17,40-42,44-51,53-54,56,60,62-63,72-73,78,806-07,87	31	(D)	314	(D)	37

See footnotes at end of

Table B-32. Total (company, Federal, and other) funds for industrial applied R&D performance, by industry, by secondary product field: 1989 (continued)

[Dollars in millions]

Industry	SIC Code	Primary metals		Fabricated metal products
		Ferrous metals and products 331-32 3398-99	Nonferrous metal and products 333-36	Ordnance and accessories n.e.c. 348
Total		$171	$61	$304
Food, kindred, and tobacco products	20,21	(D)	(D)	0
Textiles and apparel	22,23	0	0	0
Lumber, wood products, and furniture	24,25	0	0	0
Paper and allied products	26	0	0	0
Chemicals and allied products	28	0	9	0
Industrial chemicals	281-82,286	0	(D)	0
Drugs and medicines	283	0	(D)	0
Other chemicals	284-85,287-89	0	(D)	0
Petroleum refining and extraction	13,29	0	(D)	0
Rubber products	30	(D)	(D)	0
Stone, clay, and glass products	32	0	0	0
Primary metals	33	85	24	(D)
Ferrous metals and products	331-32,3398-99	(D)	(D)	0
Nonferrous metals and products	333-36	(D)	(D)	(D)
Fabricated metal products	34	(D)	(D)	(D)
Machinery	35	(D)	0	(D)
Office, computing, and accounting machines	357	0	0	0
Other machinery, except electrical	351-56,358-59	(D)	0	(D)
Electrical equipment	36	(D)	(D)	(D)
Radio and TV receiving equipment	365	0	0	0
Communication equipment	366	0	(D)	(D)
Electronic components	367	0	0	0
Other electrical equipment	361-64,369	(D)	0	0
Transportation equipment	37	(D)	(D)	118
Motor vehicles and motor vehicles equipment	371	(D)	(D)	(D)
Other transportation equipment	373-75,379	(D)	(D)	(D)
Aircraft and missiles	372,376	18	1	(D)
Professional and scientific instruments	38	(D)	(D)	0
Scientific and mechanical measuring instruments	381-82	(D)	(D)	0
Optical, surgical, photographic, and other instruments	383-87	0	0	0
Other manufacturing industries	27,31,39	0	(D)	0
Nonmanufacturing industries	10-11,14-17,40-42,44-51,53-54,56,60,62-63,72-73,78,806-07,87	(D)	(D)	(D)

See footnotes at end of

Table B-32. Total (company, Federal, and other) funds for industrial applied R&D performance, by industry, by secondary product field: 1989 (continued)

[Dollars in millions]

Industry	SIC Code	Machinery					
		Engines and turbines 351	Farm machinery and equipment 352	Construction, mining, and materials handling machinery 353	Metal-working machinery and equipment 354	Office, computing and accounting machines 357	Other machinery, except electrical 355-56, 358-59
Total		$834	$177	$370	$119	$6,804	$244
Food, kindred, and tobacco products	20,21	0	(D)	0	0	0	(D)
Textiles and apparel	22,23	0	0	0	0	0	(D)
Lumber, wood products, and furniture	24,25	0	(D)	(D)	0	(D)	0
Paper and allied products	26	0	0	0	(D)	(D)	(D)
Chemicals and allied products	28	0	(D)	0	0	0	(D)
Industrial chemicals	281-82,286	0	(D)	0	0	0	0
Drugs and medicines	283	0	0	0	0	0	(D)
Other chemicals	284-85,287-89	0	0	0	0	0	0
Petroleum refining and extraction	13,29	0	0	(D)	(D)	(D)	0
Rubber products	30	4	0	(D)	0	0	(D)
Stone, clay, and glass products	32	0	0	0	(D)	0	0
Primary metals	33	0	0	0	(D)	0	(D)
Ferrous metals and products	331-32,3398-99	0	0	0	0	0	(D)
Nonferrous metals and products	333-36	0	0	0	(D)	0	(D)
Fabricated metal products	34	0	0	(D)	7	0	(D)
Machinery	35	356	166	331	70	6,196	75
Office, computing, and accounting machines	357	0	0	0	0	(D)	(D)
Other machinery, except electrical	351-56,358-59	356	166	331	70	(D)	(D)
Electrical equipment	36	(D)	0	4	(D)	265	39
Radio and TV receiving equipment	365	0	0	0	0	0	0
Communication equipment	366	0	0	(D)	0	(D)	28
Electronic components	367	0	0	0	0	(D)	(D)
Other electrical equipment	361-64,369	(D)	0	(D)	(D)	(D)	(D)
Transportation equipment	37	445	6	(D)	29	(D)	56
Motor vehicles and motor vehicles equipment	371	(D)	(D)	(D)	(D)	(D)	(D)
Other transportation equipment	373-75,379	(D)	(D)	(D)	0	(D)	(D)
Aircraft and missiles	372,376	131	(D)	(D)	(D)	(D)	(D)
Professional and scientific instruments	38	0	0	0	0	(D)	(D)
Scientific and mechanical measuring instruments	381-82	0	0	0	0	(D)	(D)
Optical, surgical, photographic, and other instruments	383-87	0	0	0	0	(D)	0
Other manufacturing industries	27,31,39	0	0	0	0	(D)	(D)
Nonmanufacturing industries	10-11,14-17,40-42,44-51,53-54,56,60,62-63,72-73,78,806-07,87	29	0	(D)	(D)	301	39

See footnotes at end of

Table B-32. Total (company, Federal, and other) funds for industrial applied R&D performance, by industry, by secondary product field: 1989 (continued)

[Dollars in millions]

Industry	SIC Code	Electrical equipment					
		Electric transmis- sionn and distribu- tion equipment 361,3825	Electri- cal in- dustrial appa- ratus 362	Radio and television receiving sets, except communi- cation types 365	Communi- cations equipment 366	Elec- tronic components and accessories 367	Other electrical equipment and supplies 363-64, 368-69
Total		$168	$150	$106	$5,709	$3,865	$497
Food, kindred, and tobacco products	20,21	0	(D)	0	(D)	(D)	(D)
Textiles and apparel	22,23	0	(D)	0	0	(D)	0
Lumber, wood products, and furniture	24,25	0	0	0	0	0	0
Paper and allied products	26	0	(D)	0	0	(D)	0
Chemicals and allied products	28	0	0	0	0	(D)	(D)
Industrial chemicals	281-82,286	0	0	0	0	(D)	(D)
Drugs and medicines	283	0	0	0	0	(D)	0
Other chemicals	284-85,287-89	0	0	0	0	3	0
Petroleum refining and extraction	13,29	0	0	0	0	(D)	0
Rubber products	30	0	(D)	0	0	(D)	(D)
Stone, clay, and glass products	32	0	0	(D)	(D)	(D)	0
Primary metals	33	(D)	(D)	0	(D)	9	(D)
Ferrous metals and products	331-32,3398-99	0	(D)	0	0	0	0
Nonferrous metals and products	333-36	(D)	0	0	(D)	9	(D)
Fabricated metal products	34	(D)	(D)	0	(D)	8	(D)
Machinery	35	(D)	17	0	(D)	(D)	133
Office, computing, and accounting machines	357	(D)	0	0	(D)	(D)	(D)
Other machinery, except electrical	351-56,358-59	0	17	0	(D)	13	(D)
Electrical equipment	36	25	36	(D)	3,594	1,219	113
Radio and TV receiving equipment	365	0	0	0	0	(D)	0
Communication equipment	366	(D)	(D)	(D)	3,291	143	(D)
Electronic components	367	(D)	(D)	(D)	(D)	1,039	64
Other electrical equipment	361-64,369	23	27	(D)	(D)	(D)	(D)
Transportation equipment	37	(D)	62	(D)	693	918	(D)
Motor vehicles and motor vehicles equipment	371	(D)	(D)	(D)	(D)	(D)	(D)
Other transportation equipment	373-75,379	(D)	(D)	0	(D)	(D)	0
Aircraft and missiles	372,376	(D)	(D)	(D)	472	581	(D)
Professional and scientific instruments	38	0	14	(D)	46	77	18
Scientific and mechanical measuring instruments	381-82	0	(D)	(D)	(D)	68	(D)
Optical, surgical, photographic, and other instruments	383-87	0	(D)	0	(D)	6	(D)
Other manufacturing industries	27,31,39	0	0	0	0	0	(D)
Nonmanufacturing industries	10-11,14-17,40-42,44-51,53-54,56,60,62-63,72-73,78,806-07,87	51	(D)	(D)	475	219	11

See footnotes at end of

Table B-32. Total (company, Federal, and other) funds for industrial applied R&D performance, by industry, by secondary product field: 1989 (continued)

[Dollars in millions]

Industry	SIC Code	Transportation equipment				Professional and scientific instruments	
		Motor vehicles and equipment 371	Other transpor-tation equipment 379	Aircraft and parts 372	Guided missiles and space-craft 376	Scientific and mechanical measuring instruments 381-82	Optical, surgical, photo-graphic and other instruments 383-87
Total		(D)	(D)	$5,839	$2,338	$647	$430
Food, kindred, and tobacco products	20,21	$0	$0	0	0	0	0
Textiles and apparel	22,23	(D)	0	(D)	0	0	0
Lumber, wood products, and furniture	24,25	0	0	0	0	(D)	(D)
Paper and allied products	26	(D)	0	0	0	(D)	0
Chemicals and allied products	28	0	(D)	0	0	(D)	(D)
Industrial chemicals	281-82,286	0	0	0	0	(D)	(D)
Drugs and medicines	283	0	0	0	0	(D)	(D)
Other chemicals	284-85,287-89	0	(D)	0	0	(D)	(D)
Petroleum refining and extraction	13,29	(D)	(D)	0	0	(D)	(D)
Rubber products	30	(D)	(D)	0	(D)	(D)	0
Stone, clay, and glass products	32	28	0	(D)	(D)	(D)	(D)
Primary metals	33	(D)	(D)	(D)	(D)	(D)	0
Ferrous metals and products	331-32,3398-99	0	(D)	0	0	0	0
Nonferrous metals and products	333-36	(D)	(D)	(D)	(D)	(D)	0
Fabricated metal products	34	5	1	(D)	(D)	(D)	0
Machinery	35	23	(D)	(D)	(D)	(D)	(D)
Office, computing, and accounting machines	357	0	0	0	0	(D)	(D)
Other machinery, except electrical	351-56,358-59	23	(D)	(D)	(D)	5	(D)
Electrical equipment	36	(D)	13	68	(D)	53	56
Radio and TV receiving equipment	365	0	0	0	0	0	0
Communication equipment	366	(D)	(D)	(D)	(D)	(D)	(D)
Electronic components	367	0	0	(D)	(D)	(D)	(D)
Other electrical equipment	361-64,369	(D)	(D)	4	0	(D)	(D)
Transportation equipment	37	(D)	(D)	5,655	2,021	(D)	(D)
Motor vehicles and motor vehicles equipment	371	(D)	(D)	(D)	(D)	(D)	0
Other transportation equipment	373-75,379	(D)	(D)	(D)	(D)	0	0
Aircraft and missiles	372,376	14	48	5,439	1,375	(D)	(D)
Professional and scientific instruments	38	2	0	(D)	(D)	223	183
Scientific and mechanical measuring instruments	381-82	2	0	(D)	0	(D)	(D)
Optical, surgical, photographic, and other instruments	383-87	(D)	0	0	(D)	(D)	(D)
Other manufacturing industries	27,31,39	0	0	0	0	0	(D)
Nonmanufacturing industries	10-11,14-17,40-42,44-51,53-54,56,60,62-63,72-73,78,806-07,87	(D)	(D)	90	296	132	6

(D) Data have been withheld to avoid disclosing operations of individual companies.
(S) Data have been withheld due to imputation of 50 percent or more.
(1) Less than $0.5 million.

NOTE: Imputation of R&D expenditures by product field was eliminated beginning in 1985. This table, therefore, contains only data reported by survey respondents. See table B-31 for coverage ratios showing the percentage of each industry's applied research and development funds that respondents distributed by product field.

SOURCE: National Science Foundation, SRS

Table B-33. Total (company, Federal, and other) funds for industrial energy R&D performance, by industry: 1979-89, and projected 1990

[Dollars in millions]

Industry	SIC code	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	Project 1990
Total	....	$3,643	$4,162	$4,216	$4,240	$4,345	$4,446	$3,954	$3,358	$3,576	$3,738	$3,587	$3,734
Food, kindred, and tobacco products(1)	20,21	(2)	4	5	(2)	(2)	(S)	2	2	(S)	(3)	(D)	(D)
Textiles and apparel	22,23	(2)	(2)	(2)	(2)	(2)	2	1	(D)	(D)	(D)	(D)	0
Lumber, wood products, and furniture	24,25	(2)	3	4	5	5	5	3	(D)	(D)	(D)	(D)	(D)
Paper and allied products	26	3	3	2	3	3	6	(D)	(D)	1	1	(D)	(D)
Chemicals and allied products	28	220	257	312	347	345	191	162	(S)	(S)	(S)	130	(S)
Industrial chemicals	281-82,286	(2)	246	305	338	335	181	(D)	(D)	(D)	(D)	(D)	(D)
Drugs and medicines	283	(2)	(2)	(2)	(2)	(2)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
Other chemicals	284-85,287-89	(2)	(2)	(2)	(2)	(2)	(D)	2	2	2	4	1	1
Petroleum refining and extraction	13,29	776	845	1,067	1,162	1,284	1,356	1,199	999	914	989	989	1039
Rubber products	30	12	15	17	14	17	16	(D)	(D)	(D)	(D)	(D)	(D)
Stone, clay, and glass products	32	17	21	24	17	7	5	(D)	(D)	1	(D)	1	(S)
Primary metals	33	72	78	80	101	92	(S)	(S)	74	18	21	(D)	28
Ferrous metals and products	331-32,3398-99	19	20	20	22	35	35	26	(D)	(D)	(D)	(D)	(D)
Nonferrous metals and products	333-36	48	58	59	79	57	(S)	(S)	(D)	(D)	(D)	(D)	(D)
Fabricated metal products	34	(2)	(2)	(2)	54	31	(D)	8	(D)	(D)	(D)	14	14
Machinery	35	83	108	127	183	163	201	240	261	(D)	230	232	240
Office, computing, and accounting machines	357	13	17	6	16	(2)	(S)	12	(D)	(D)	(D)	(D)	(D)
Other machinery, except electrical	351-56,358-59	70	91	121	167	144	179	228	(D)	(D)	(D)	(D)	(D)
Electrical equipment	36	843	917	908	831	813	752	733	(D)	578	744	763	815
Radio and TV receiving equipment	365	0	3	(2)	5	0	0	0	0	0	0	0	0
Communication equipment	366	(2)	(2)	(2)	155	150	(D)	115	(D)	(D)	(D)	(D)	(D)
Electronic components	367	13	12	15	40	82	(D)	(D)	(D)	(D)	(D)	(D)	(D)
Other electrical equipment	361-64,369	(2)	(2)	(2)	631	581	618	(D)	(D)	(S)	(D)	(D)	(D)
Transportation equipment	37						(D)	(S)	(S)	(S)	(D)	(D)	(D)
Motor vehicles and motor vehicles equipment	371	(2)	(2)	(2)	(2)	(2)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
Other transportation equipment	373-75,379	(2)	(2)	(2)	2	2	1	(D)	(D)	(D)	(D)	(D)	(D)
Aircraft and missiles	372,376	372	446	412	363	425	661	681	537	754	726	677	725

See footnotes at end of

Table B-33. Total (company, Federal, and other) funds for industrial energy R&D performance, by industry: 1979-89, and projected 1990 (continued)

[Dollars in millions]

Industry	SIC code	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	Project 1990
Professional and scientific instruments............	38	$28	$45	$53	$54	$45	$36	(D)	(D)	$17	$16	$12	$14
Scientific and mechanical measuring instruments..	381-82	24	40	(2)	(2)	(2)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
Optical, surgical, photographic, and other instruments....................................	383-87	4	5	(2)	(2)	(2)	(D)	(D)	0	(D)	(D)	(D)	(D)
Other manufacturing industries (1).................	27,31,39	7	19	(2)	12	17	12	0	0	0	0	(D)	(D)
Nonmanufacturing industries........................	10-11,14-17,40-42,44-51,53-54,56,60,62-63,72-73,78,806-07,87	324	333	374	375	349	424	338	328	433	489	497	528

(1) Until 1984, tobacco products, SIC 21, was included with "other manufacturing industries."
(2) Not separately available but included in total. See general notes.
(3) Less than $0.5 million.
(D) Data have been withheld to avoid disclosing operations of individual companies.
(S) Data have been withheld due to imputation of more than 50 percent.

SOURCE: National Science Foundation, SRS

Table B-34. Company and other (except Federal) funds for industrial energy R&D performance, by selected industry: 1979-89, and projected 1990

[Dollars in millions]

Industry	SIC code	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	Projected 1990
Total..............................	....	$2,230	$2,599	$2,680	$2,762	$2,842	$2,962	$2,537	$2,167	$2,410	$2,353	$2,218	$2,343
Chemicals and allied products.............	28	(1)	(1)	149	178	166	169	(D)	(D)	(D)	(D)	99	(D)
Petroleum refining and extraction..........	13,29	623	699	957	1,096	1,218	(D)	1,145	957	911	983	985	1032
Machinery.................................	35	(1)	(1)	(1)	(1)	(1)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
Electrical equipment......................	36	219	205	203	146	132	123	71	(D)	(D)	(D)	(D)	(D)
Aircraft and missiles.....................	372,376	113	163	124	99	(1)	190	264	236	(D)	279	248	299
All other manufacturing industries.........	....	(1)	(1)	1,053	1,079	(1)	779	610	497	564	478	501	467
Nonmanufacturing industries...............	10-11,14-17,40-42,44-51,53-54,56,60,62-63,72-73,78,806-07,87	141	154	194	164	143	189	84	(D)	170	(S)	(S)	(S)

(1) Not separately available but included in total. See general notes.
(D) Data have been withheld to avoid disclosing operations of individual companies.
(S) Data have been withheld due to imputation of more than 50 percent.

SOURCE: National Science Foundation, SRS

Table B-35. Federal funds for industrial energy R&D performance, by selected industry: 1979-89, and projected 1990

[Dollars in millions]

Industry	SIC code	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	Projected 1990
Total..............................	....	$1,413	$1,563	$1,536	$1,478	$1,503	$1,484	$1,417	$1,191	$1,166	$1,385	$1,369	$1,391
Chemicals and allied products............	28	(1)	(1)	163	169	179	22	(D)	(D)	(D)	(D)	31	(D)
Petroleum refining and extraction.........	13,29	153	146	110	66	66	(D)	54	42	3	6	4	7
Machinery................................	35	(1)	(1)	(1)	(1)	(1)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
Electrical equipment.....................	36	624	711	705	685	681	629	662	(D)	(D)	(D)	(D)	(D)
Aircraft and missiles....................	372,376	259	283	288	264	(1)	471	417	302	(D)	447	429	426
All other manufacturing industries........	....	(1)	(1)	90	83	(1)	52	13	4	5	(D)	(D)	(D)
Nonmanufacturing industries..............	10-11,14-17,40-42,44-51,53-54,56,60,62-63,72-73,78,806-07,87	183	179	180	211	206	235	254	(D)	263	(S)	(S)	(S)

(1) Not separately available but included in total. See general notes.
(D) Data have been withheld to avoid disclosing operations of individual companies.
(S) Data have been withheld due to imputation of more than 50 percent.

SOURCE: National Science Foundation, SRS

Table B-36. Total (company, Federal, and other) funds for industrial energy R&D performance, by primary energy source: 1979-89, and projected 1990

[Dollars in millions]

Primary energy source	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	Projected 1990
Total.........	$3,643	$4,162	$4,216	$4,240	$4,345	$4,446	$3,954	$3,358	$3,576	$3,738	$3,587	$3,734
Fossil fuels........	1,063	1,228	1,437	1,491	1,573	1,738	1,876	1,476	1,548	1,606	1,577	1,616
Oil................	557	(1)	772	(1)	905	(1)	1,395	(1)	(S)	(1)	(S)	(S)
Gas................	113	(1)	208	(1)	255	(1)	189	(1)	191	(1)	(S)	(S)
Shale..............	24	(1)	57	(1)	48	(1)	125	(1)	11	(1)	71	66
Coal...............	313	(1)	383	(1)	(2)	(1)	150	(1)	46	(1)	(S)	(S)
Synthetic fossil fuels..........	236	(1)	210	(1)	(2)	(1)	111	(1)	23	(1)	14	(S)
Mining..........	1	(1)	31	(1)	(2)	(1)	8	(1)	3	(1)	(S)	(S)
Other...........	76	(1)	142	(1)	(2)	(1)	31	(1)	(S)	(1)	(S)	(S)
Other fossil fuels	56	(1)	17	(1)	(2)	(1)	17	(1)	51	(1)	(S)	(S)
Nuclear.............	1,037	1,056	1,037	1,078	1,118	1,113	1,212	979	926	1,097	988	1,030
Fission...........	913	(1)	866	(1)	973	(1)	1,062	(1)	859	(1)	907	947
Fusion............	124	(1)	171	(1)	145	(1)	150	(1)	(S)	(1)	81	(S)
Total geothermal, solar, and conservation and utilization........	1,156	(1)	774	(1)	1,424	1,218	471	504	421	497	535	605
Geothermal........	149	(1)	71	(1)	(2)	(1)	54	(1)	48	(1)	15	(D)
Solar.............	321	(1)	298	(1)	(2)	(1)	96	(1)	95	(1)	(S)	(D)
Conservation and utilization......	686	(1)	405	(1)	(2)	(1)	321	(1)	281	(1)	383	448
All other energy....	387	(1)	968	(1)	230	377	395	399	(S)	538	487	483

(S) Data have been withheld due to imputation of more than 50 percent.
(D) Data have been withheld to avoid disclosing the operations of individual companies.
(1) Data not collected.
(2) Not separately available, but included in total. See general notes.

NOTE: Detailed data for 1979, 1981, 1983, 1985, and 1987 were estimated on the basis of (a) data actually reported in those years, (b) revised data for those years reported on the 1980, 1982, 1984, 1986, and 1988 survey forms and (c) adjustments to new samples in 1981 and 1987.

SOURCE: National Science Foundation, SRS

Table B-37. Company and other (except Federal) funds for industrial energy R&D performance, by primary energy source: 1979-89, and projected 1990

[Dollars in millions]

Primary energy source	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	Projected 1990
Total	$2,230	$2,599	$2,680	$2,762	$2,842	$2,962	$2,537	$2,167	$2,410	$2,353	$2,218	$2,343
Fossil fuels	788	993	1,257	1,361	1,455	1,509	1,797	(D)	(D)	1,543	1,417	1,466
Oil	529	(1)	746	(1)	(2)	(1)	1,381	(1)	(S)	(1)	(S)	(S)
Gas	109	(1)	(2)	(1)	(2)	(1)	(D)	(1)	(S)	(1)	(S)	(S)
Shale	(2)	(1)	(2)	(1)	(2)	(1)	124	(1)	(S)	(1)	(S)	64
Coal	130	(1)	244	(1)	(2)	(1)	(S)	(1)	29	(1)	(S)	(S)
Synthetic fossil fuels	84	(1)	132	(1)	(2)	(1)	91	(1)	(S)	(1)	(D)	(S)
Mining	1	(1)	24	(1)	(2)	(1)	8	(1)	(D)	(1)	(D)	1
Other	45	(1)	89	(1)	(2)	(1)	(S)	(1)	(D)	(1)	(S)	(S)
Other fossil fuels	(2)	(1)	(2)	(1)	(2)	(1)	17	(1)	(S)	(1)	(S)	(S)
Nuclear	169	150	126	99	90	101	150	91	109	118	38	62
Fission	167	(1)	70	(1)	71	(1)	135	(1)	82	(1)	26	47
Fusion	2	(1)	56	(1)	19	(1)	15	(1)	(S)	(1)	12	15
Total geothermal, solar, and conservation and utilization	1,054	(1)	573	(1)	1,147	1,086	313	(D)	(D)	319	397	464
Geothermal	122	(1)	40	(1)	(2)	(1)	27	(1)	(D)	(1)	(D)	8
Solar	251	(1)	199	(1)	(2)	(1)	51	(1)	41	(1)	(D)	107
Conservation and utilization	681	(1)	334	(1)	(2)	(1)	235	(1)	(D)	(1)	285	349
All other energy	219	(1)	724	(1)	150	267	277	(D)	(D)	373	366	351

(D) Data have been withheld to avoid disclosing operations of individual companies.
(S) Data have been withheld due to imputation of more than 50 percent.
(1) Data not collected.
(2) Not separately available but included in total. See general notes.

NOTE: Detailed data for 1979, 1981, 1983, 1985, and 1987 were estimated on the basis of (a) data actually reported in those years, (b) revised data for those years reported on the 1980, 1982, 1984, 1986, and 1988 survey forms and (c) adjustments to new samples in 1981 and 1987.

SOURCE: National Science Foundation, SRS

Table B-38. Federal funds for industrial energy R&D performance, by primary energy source: 1979-89, and projected 1990

[Dollars in millions]

Primary energy source	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	Projected 1990
Total	$1,413	$1,563	$1,536	$1,478	$1,503	$1,484	$1,417	$1,191	$1,166	$1,385	$1,369	$1,391
Fossil fuels	275	235	180	130	117	228	78	(D)	(D)	63	160	(S)
Oil	29	(1)	26	(1)	(2)	(1)	13	(1)	(S)	(1)	(S)	(S)
Gas	4	(1)	(2)	(1)	10	(1)	(D)	(1)	(D)	(1)	(S)	(S)
Shale	(2)	(1)	(2)	(1)	1	(1)	1	(1)	(D)	(1)	(S)	2
Coal	183	(1)	139	(1)	76	(1)	(S)	(1)	17	(1)	(S)	(S)
Synthetic fossil fuels	152	(1)	78	(1)	(2)	(1)	20	(1)	8	(1)	(D)	6
Mining	0	(1)	7	(1)	(2)	(1)	0	(1)	(D)	(1)	(D)	(S)
Other	31	(1)	53	(1)	(2)	(1)	(S)	(1)	(D)	(1)	(S)	(S)
Other fossil fuels	(2)	(1)	(2)	(1)	16	(1)	0	(1)	1	(1)	(S)	(S)
Nuclear	868	906	911	979	1,029	1,013	1,063	888	817	979	950	968
Fission	746	(1)	796	(1)	902	(1)	928	(1)	777	(1)	881	900
Fusion	122	(1)	115	(1)	127	(1)	135	(1)	(S)	(1)	69	68
Total geothermal, solar, and conservation and utilization	102	(1)	201	(1)	277	132	158	(D)	(D)	178	138	141
Geothermal	27	(1)	31	(1)	(2)	(1)	26	(1)	(D)	(1)	(D)	(D)
Solar	70	(1)	99	(1)	(2)	(1)	45	(1)	37	(1)	(D)	(D)
Conservation and utilization	5	(1)	71	(1)	80	(1)	87	(1)	(D)	(1)	98	99
All other energy	168	(1)	244	(1)	80	110	118	(D)	(D)	165	121	132

(D) Data have been withheld to avoid disclosing operations of individual companies.
(S) Data have been withheld due to imputation of more than 50 percent.
(1) Data not collected.
(2) Not separately available but included in total. See general notes.

NOTE: Detailed data for 1979, 1981, 1983, 1985, and 1987 were estimated on the basis of (a) data actually reported in those years, (b) revised data for those years reported on the 1980, 1982, 1984, 1986, and 1988 survey forms and (c) adjustments to new samples in 1981 and 1987.

SOURCE: National Science Foundation, SRS

Table B-39. Number of companies performing energy research and development, by industry, by size of company: 1989

Industry	SIC code	Size of company [Based on number of employees]											
		Less than 500 employees		500 to 999 employees		1,000 to 4,999 employees		5,000 to 9,999 employees		10,000 to 24,999 employees		25,000 or more employees	
		Total	Energy	Total	Energy	Total	Energy	Total	Energy	Total	Energy	Total	Energy
Total		22,486	27	761	6	1,043	34	187	25	175	36	123	25
Food, kindred, and tobacco products	20,21	8	0	35	0	48	0	14	2	13	1	15	0
Textiles and apparel	22,23	286	0	106	0	44	0	8	0	9	0	4	0
Lumber, wood products, and furniture	24,25	78	0	27	0	37	1	7	1	4	0	1	0
Paper and allied products	26	261	0	13	0	32	0	9	1	8	0	3	1
Chemicals and allied products	28	2,325	1	39	1	68	8	9	1	21	1	9	1
Industrial chemicals	281-82,286	204	0	11	1	23	4	6	1	4	0	5	1
Drugs and medicines	283	407	0	6	0	12	0	1	0	10	1	3	0
Other chemicals	284-85,287-89	1,714	1	22	0	33	4	2	0	7	0	1	0
Petroleum refining	29	104	0	3	0	11	0	5	2	4	4	7	6
Rubber products	30	308	0	35	0	133	2	5	1	6	0	1	0
Stone, clay, and glass products	32	86	0	26	1	29	1	6	1	6	2	2	0
Primary metals	33	169	0	23	0	41	1	10	1	7	3	3	1
Ferrous metals and products	331-32,3398-99	80	0	10	0	20	0	7	1	3	1	2	1
Nonferrous metals and products	333-36	89	0	13	0	21	1	3	0	4	2	1	0
Fabricated metal products	34	1,907	11	57	0	60	0	10	0	7	0	0	0
Machinery	35	2,535	2	98	1	124	3	26	1	11	3	7	1
Office, computing, and accounting machines	357	431	1	24	0	28	0	11	0	3	0	4	0
Other machinery, except electrical	351-56,358-59	2,104	1	74	1	96	3	15	1	8	3	3	1
Electrical equipment	36	3,424	1	104	2	114	2	15	0	15	2	15	4
Radio and TV receiving equipment	365	172	0	3	0	3	0	1	0	0	0	0	0
Communication equipment	366	613	1	15	0	20	1	4	0	4	0	9	2
Electronic components	367	1,267	0	35	1	38	0	4	0	5	1	2	1
Other electrical equipment	361-64,369	1,372	0	51	1	53	1	6	0	6	1	4	1
Transportation equipment	37	150	0	32	0	45	1	9	2	16	4	18	7
Motor vehicles & motor vehicles equipment	371	100	0	19	0	25	1	5	1	6	1	4	1
Other transportation equipment	373-75,379	49	0	6	0	9	0	0	0	4	1	0	0
Aircraft and missiles	372,376	1	0	7	0	11	0	4	1	6	2	14	6

Table B-39. Number of companies performing energy research and development, by industry, by size of company: 1989 (continued)

Industry	SIC code	Size of company [Based on number of employees] Less than 500 employees		500 to 999 employees		1,000 to 4,999 employees		5,000 to 9,999 employees		10,000 to 24,999 employees		25,000 or more employees	
		Total	Energy	Total	Energy	Total	Energy	Total	Energy	Total	Energy	Total	Energy
Professional and scientific instruments.....	38	1,808	0	38	0	44	1	10	2	3	0	4	0
Scientific and mechanical measuring instruments..............................	381-82	979	0	15	0	18	0	5	2	1	0	0	0
Optical, surgical, photographic, and other instruments...............................	383-87	829	0	23	0	26	1	5	0	2	0	4	0
Other manufacturing industries..............	27,31,39	310	0	36	0	38	1	7	0	7	0	0	0
Nonmanufacturing industries.................	10-11,14-17,40-42,44-51,53-54,56,60,62-63,72-73,78,806-07,87	8,727	12	89	1	175	13	37	10	38	16	34	4

SOURCE: National Science Foundation, SRS

Table B-40. Total (company, Federal, and other) funds for industrial pollution-abatement R&D performance, by industry: 1979-89, and projected 1990

[Dollars in millions]

Industry	SIC code	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	Projected 1990
Total................................	....	$1,249	$1,202	(S)	(S)	(S)	$1,060	(S)	(S)	(S)	(S)	(S)	(S)
Food, kindred, and tobacco products(1)......	20,21	2	3	1	1	9	12	1	1	1	1	2	(D)
Textiles and apparel.........................	22,23	(2)	(2)	(2)	(2)	(2)	(S)	(3)	(D)	(3)	(S)	(D)	(1)
Lumber, wood products, and furniture........	24,25	3	4	5	3	2	(D)	1	(D)	(D)	(D)	(D)	(D)
Paper and allied products....................	26	(2)	(2)	(2)	9	6	7	8	7	7	9	19	19
Chemicals and allied products...............	28	146	178	186	191	167	158	(S)	168	117	136	78	103
Industrial chemicals.......................	281-82,286	128	157	165	173	144	140	(S)	(S)	(D)	117	61	(D)
Drugs and medicines........................	283	4	4	6	6	11	8	(D)	(D)	(D)	(D)	(D)	(D)
Other chemicals............................	284-85,287-89	13	16	15	12	12	10	14	(D)	12	(D)	(D)	10
Petroleum refining and extraction...........	13,29	80	95	92	97	81	88	60	63	51	60	76	95
Rubber products..............................	30	3	3	(2)	2	1	(D)	(D)	(D)	(D)	(S)	1	1
Stone, clay, and glass products.............	32	9	11	9	7	9	(S)	3	4	(D)	(D)	(D)	(D)
Primary metals...............................	33	29	30	24	22	21	21	20	8	5	9	10	11
Ferrous metals and products...............	331-32,3398-99	14	14	15	13	10	13	11	2	(D)	(D)	(D)	(D)
Nonferrous metals and products............	333-36	15	15	9	9	11	8	9	6	(D)	(D)	(D)	(D)
Fabricated metal products...................	34	6	7	3	11	7	14	6	(D)	(D)	(D)	1	1
Machinery....................................	35	31	30	34	30	27	26	26	33	38	46	110	107
Office, computing, and accounting machines	357	0	1	0	0	0	(D)	0	0	0	0	0	0
Other machinery, except electrical........	351-56,358-59	30	29	34	30	27	(D)	26	33	38	46	110	107
Electrical equipment.........................	36	34	39	39	24	18	(D)	(D)	5	(D)	(D)	(D)	(D)
Radio and TV receiving equipment..........	365	0	0	0	0	0	0	0	0	0	0	0	0
Communication equipment...................	366	5	6	(2)	(2)	(2)	(D)	1	1	(D)	(D)	(D)	(D)
Electronic components.....................	367	(2)	(2)	(2)	(2)	(2)	(S)	(3)	(D)	(D)	0	1	1
Other electrical equipment................	361-64,369	(2)	(2)	(2)	(2)	12	(D)	(D)	(D)	(D)	(D)	(D)	(D)
Transportation equipment.....................	37						(S)	(S)	(S)	(S)	(S)	(S)	(S)
Motor vehicles & motor vehicles equipment.	371	(2)	(2)	(2)	(2)	(2)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
Other transportation equipment............	373-75,379	0	(2)	0	0	(2)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
Aircraft and missiles.....................	372,376	64	38	30	(2)	(2)	(D)	(S)	87	123	103	119	144

See footnotes at end of

Table B-40. Total (company, Federal, and other) funds for industrial pollution-abatement R&D performance, by industry: 1979-89, and projected 1990 (continued)

[Dollars in millions]

Industry	SIC code	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	Projected 1990
Professional and scientific instruments	38	3	(2)	(2)	(2)	3	2	2	(D)	(D)	3	(D)	(D)
Scientific and mechanical measuring instruments	381-82	(2)	(2)	(2)	(2)	1	(D)	(D)	(D)	(D)	(D)	(D)	(D)
Optical, surgical, photographic, and other instruments	383-87	(2)	(2)	(2)	(2)	2	(D)	(D)	(D)	(D)	(D)	(D)	(D)
Other manufacturing industries	27,31,39	2	3	(2)	(2)	2	3	(S)	0	(D)	(D)	1	1
Nonmanufacturing industries	10-11,14-17,40-42,44-51,53-54,56,60,62-63,72-73,78,806-07,87	104	79	77	65	124	113	118	80	113	(S)	(S)	(S)

(D) Data have been withheld to avoid disclosing operations of individual companies.
(S) Data have been withheld due to imputation of more than 50 percent.
(1) Until 1984, tobacco products, SIC 21, was included with "other manufacturing industries."
(2) Not separately available but included in total. See general notes.
(3) Less than $0.5 million.

SOURCE: National Science Foundation, SRS

Table B-41. Company and other (except Federal) funds for industrial pollution-abatement R&D performance, by selected industry: 1979-89, and projected 1990

[Dollars in millions]

Industry	SIC code	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	Projected 1990
Total		$1,139	$1,095	(S)	(S)	(S)	(S)	(S)	(S)	(S)	(S)	(S)	(S)
Chemicals and allied products	28	113	130	128	123	101	(D)	(S)	(D)	(D)	(D)	(D)	(D)
Petroleum refining and extraction	13,29	(1)	93	92	97	82	(D)	61	63	51	60	(D)	(D)
Machinery	35						(D)	(D)	33	38	46	(D)	(D)
Electrical equipment	36	17	19	19	12	13	(D)	(D)	(D)	(D)	(D)	(D)	(D)
Aircraft and missiles	372,376	(1)	26	20	22	17	24	(D)	(D)	62	(D)	69	(D)
All other manufacturing industries		(1)	705	(1)	(1)	(1)	565	(D)	676	(D)	(D)	(D)	(D)
Nonmanufacturing industries	10-11,14-17,40-42,44-51,53-54,56,60,62-63,72-73,78,806-07,87	98	63	39	38	51	47	(D)	(D)	(D)	(D)	(S)	(S)

(D) Data have been withheld to avoid disclosing operations of individual companies.
(S) Data have been withheld due to imputation of 50 percent or more.
(1) Not separately available but included in total. See general notes.

SOURCE: National Science Foundation, SRS

Table B-42. Federal funds for industrial pollution-abatement R&D performance, by selected industry: 1979-89, and projected 1990

[Dollars in millions]

Industry	SIC code	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	Projected 1990
Total		$98	$107	$129	$122	$176	$169	$169	$148	$186	$191	$193	$192
Chemicals and allied products	28	36	48	58	68	66	(D)	(D)	(D)	(D)	(D)	(D)	(D)
Petroleum refining and extraction	13,29	(1)	2	0	0	0	(D)	0	0	0	0	(D)	(D)
Machinery	35						(D)	(D)	0	0	0	(D)	(D)
Electrical equipment	36	17	20	20	12	5	(D)	(D)	(D)	(D)	(D)	(D)	(D)
Aircraft and missiles	372,376	(1)	12	10	(1)	(1)	(D)	(D)	(D)	61	(D)	50	(D)
All other manufacturing industries		(1)	6	3	(1)	(1)	(D)	(D)	(D)	(D)	0	0	0
Nonmanufacturing industries	10-11,14-17,40-42,44-51,53-54,56,60,62-63,72-73,78,806-07,87	15	16	38	26	74	67	(D)	(D)	(D)	(D)	(D)	(D)

(D) Data have been withheld to avoid disclosing information about individual companies.
(1) Not separately available but included in total. See general notes.

SOURCE: National Science Foundation, SRS

Table B-43. Total (company, Federal, and other) funds for industrial pollution-abatement R&D performance, by type of pollution: 1979-89, and projected 1990

[Dollars in millions]

Type of pollution	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	Projected 1990
Total	$1,249	$1,202	(S)	(S)	(S)	$1,060	(S)	(S)	(S)	(S)	(S)	(S)
Air	954	(1)	(S)	(1)	(S)	(1)	(S)	(1)	(S)	(1)	(S)	(S)
Automotive emission	736	(1)	(S)	(1)	(S)	(1)	(D)	(1)	(S)	(1)	(S)	(S)
Electric power plant emissions	70	(1)	27	(1)	23	(1)	12	(1)	16	(1)	36	43
All other	148	(1)	112	(1)	91	(1)	(D)	(1)	(S)	(1)	(S)	280
Water	120	(1)	105	(1)	124	(1)	(S)	(1)	(S)	(1)	(S)	(S)
Solid waste	44	(1)	96	(1)	108	(1)	(S)	(1)	206	(1)	(S)	(S)
Other	131	(1)	65	(1)	54	(1)	108	(1)	90	(1)	85	96

(D) Data have been withheld to avoid disclosing operations of individual companies.
(S) Data have been withheld due to imputation of 50 percent or more.
(1) Data not collected.

NOTE: Detailed data for 1979, 1981, 1983, and 1985 were estimated on the basis of (a) data actually reported in those years, (b) revised totals for those years which were reported on the 1980, 1982, 1984, and 1986 survey forms, and (c) adjustments due to new samples in 1981 and 1987.

SOURCE: National Science Foundation, SRS

Table B-44. Total (company, Federal, and other) funds for industrial pollution-abatement R&D performance, by type of pollution, by source of funds: 1979-89, and projected 1990

[Dollars in millions]

Type of pollution	1987			1988			1989			1990 (Projected)		
	Total	Federal	Company	Total	Federal	Company	Total	Federal	Company	Total	Federal	Company
Total	(S)	$186	(S)	(S)	$191	(S)	(S)	$193	(S)	(S)	$192	(S)
Air	(S)	(S)	(S)	(1)	(1)	(1)	(S)	(S)	(S)	(S)	66	(S)
Automotive emission	(S)	(D)	(D)	(1)	(1)	(1)	(S)	(D)	(D)	(S)	(D)	(D)
Electric power plant emissions	16	(D)	(D)	(1)	(1)	(1)	36	3	33	43	(D)	(D)
All other	(S)	(S)	(S)	(1)	(1)	(1)	(S)	(D)	(D)	280	60	220
Water	(S)	(D)	(D)	(1)	(1)	(1)	(S)	(D)	(D)	(S)	(D)	(D)
Solid waste	206	104	102	(1)	(1)	(1)	(S)	(D)	(D)	(S)	(D)	(D)
Other	90	(D)	(D)	(1)	(1)	(1)	85	8	77	96	13	83

(D) Data have been withheld to avoid disclosing operations of individual companies.
(S) Data have been withheld due to imputation of 50 percent or more.
(1) Data not collected.

SOURCE: National Science Foundation, SRS

Table B-45. Geographic distribution of funds for industrial research in selected years

[Dollars in millions]

Area	1973	1974	1975	1976	1977	1979	1981	1983	1985	1987	1989
United States	$21,249	$22,887	$24,187	$26,997	$29,825	$38,226	$51,810	$62,816	$78,203	$96,305	$101,599
Northeast	6,735	7,291	7,403	8,096	8,687	10,296	14,270	18,245	23,057	25,654	27,873
New England	2,011	2,058	2,029	2,147	2,400	3,003	3,855	4,504	6,922	8,324	8,789
Maine	8	8	9	21	24	40	(1)	(1)	(D)	41	33
New Hampshire	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(D)	94	(D)
Vermont	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(D)	247	(D)
Massachusetts	1,135	1,080	1,022	1,156	1,349	1,690	1,907	2,373	4,173	5,492	5,825
Rhode Island	44	41	45	22	24	49	87	165	198	234	139
Connecticut	732	821	832	815	876	985	1,514	1,619	1,976	2,216	2,410
Middle Atlantic	4,724	5,233	5,374	5,949	6,287	7,293	10,415	13,741	16,136	17,330	19,084
New York	1,971	2,134	2,225	2,418	2,542	2,959	4,057	5,727	7,019	6,559	8,071
New Jersey	1,407	1,512	1,547	1,717	1,900	2,191	3,355	4,200	5,547	6,141	6,381
Pennsylvania	1,347	1,537	1,602	1,814	1,845	2,143	3,003	3,814	3,569	4,630	4,632
North Central	5,468	5,756	5,821	6,574	7,777	10,013	12,692	14,672	18,001	24,224	24,615
East North Central	4,424	4,704	4,816	5,390	6,270	8,065	9,742	11,517	14,161	18,429	19,308
Ohio	1,043	1,103	1,139	1,183	1,323	1,635	1,781	2,196	2,847	3,569	3,946
Indiana	387	403	453	469	541	723	1,054	(1)	(D)	1,944	1,815
Illinois	862	970	1,042	1,226	1,360	1,673	2,077	2,205	(D)	4,284	4,050
Michigan	1,883	2,016	1,961	2,249	2,750	3,614	4,272	5,501	5,975	7,415	8,468
Wisconsin	249	212	221	263	296	420	558	(1)	676	1,217	1,030
West North Central	1,044	1,052	1,005	1,184	1,507	1,948	2,950	3,155	3,840	5,795	5,307
Minnesota	341	411	403	551	602	802	1,180	1,746	(D)	2,242	2,066
Iowa	158	175	182	144	173	150	393	276	(D)	343	363
Missouri	484	399	350	398	630	746	1,137	(1)	(D)	1,905	2,380
North Dakota	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	10	60	(S)
South Dakota	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(S)	4	4
Nebraska	7	10	9	13	14	15	28	25	(D)	62	64
Kansas	49	51	60	76	84	216	211	282	(D)	1,179	404
South	2,601	2,891	2,964	3,442	3,691	4,496	6,987	8,943	12,020	16,656	15,320
South Atlantic	1,666	1,775	1,720	1,847	2,012	2,592	4,012	4,812	6,812	9,208	8,100
Delaware	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(D)	(D)	(D)
Maryland	423	481	446	452	382	424	(1)	(1)	1,437	1,350	1,088
District of Columbia	10	24	14	8	8	33	(1)	(1)	(D)	(D)	(D)
Virginia	194	244	236	264	318	464	539	906	800	1,342	1,126
West Virginia	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(D)	87	(D)
North Carolina	203	227	235	253	268	327	546	756	(D)	1,741	1,305
South Carolina	38	30	37	87	96	82	(1)	(1)	(D)	523	386
Georgia	73	83	81	91	99	147	220	335	(D)	1,001	719
Florida	386	374	348	398	462	620	1,449	(1)	1,832	2,133	2,341
East South Central	356	388	401	427	467	402	624	969	1,209	2,534	1,640
Kentucky	73	67	74	79	100	209	170	184	(D)	249	226
Tennessee	190	231	261	282	306	(1)	(1)	(1)	(D)	649	930
Alabama	84	79	57	56	48	62	100	180	(S)	1,592	428
Mississippi	8	8	10	10	13	(1)	(1)	(1)	62	44	56
West South Central	579	728	843	1,113	1,212	1,502	2,351	3,162	3,998	4,914	5,580
Arkansas	4	9	13	12	10	11	52	(1)	(D)	135	51
Louisiana	55	74	88	98	106	83	158	247	(D)	134	168
Oklahoma	72	76	99	116	142	174	339	392	(D)	384	332
Texas	448	567	643	887	954	1,233	(1)	(1)	3,492	4,261	5,028

See footnotes at end of

Table B-45. Geographic distribution of funds for industrial research in selected years (continued)

[Dollars in millions]

Area	1973	1974	1975	1976	1977	1979	1981	1983	1985	1987	1989
West	$5,275	$5,620	$6,165	$6,855	$7,379	$10,176	$11,873	$17,173	$23,738	$27,387	$30,859
Mountain	621	622	782	923	1,034	1,139	2,135	2,738	3,496	4,464	4,095
Montana	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(D)	7	(D)
Idaho	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	419	488	(D)
Wyoming	(1)	(1)	(1)	(1)	(1)	(1)	(1)	2	3	4	(D)
Colorado	146	166	194	250	257	269	529	713	917	1,261	1,162
New Mexico	149	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(D)	993	1,034
Arizona	212	199	243	203	200	372	758	(1)	1,002	845	917
Utah	43	61	91	112	132	142	265	233	(D)	809	387
Nevada	(1)	8	11	35	72	(1)	(1)	(1)	(S)	57	29
Pacific	4,654	4,958	5,384	5,932	6,345	9,037	9,738	14,435	20,242	22,923	26,764
Washington	(1)	484	499	610	681	(1)	(1)	(1)	2,183	3,071	2,716
Oregon	(1)	50	51	57	77	116	(1)	(1)	(D)	294	355
California	4,241	4,423	4,834	5,263	5,600	7,437	7,626	(1)	(S)	19,475	23,675
Alaska	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(D)	10	9
Hawaii	2	1	(1)	(1)	(1)	(1)	(1)	(1)	12	73	9
Undistributed funds	1,146	1,302	1,803	2,030	2,291	3,245	(1)	3,783	1,388	2,384	2,932

(D) Data have been withheld to avoid disclosing information about individual companies.
(S) Data have been withheld due to imputation of 50 percent or more.
(1) Not separately available but included on total. See general notes.

NOTE: Though U.S. totals have been revised, data for individual states were not adjusted (see section A, Historical Data Revisions). The differences between revised data and that which was originally published were added to the "undistributed funds" categories.

SOURCE: National Science Foundation, SRS

Table B-46. Geographic distribution of funds for industrial R&D performance, by source of funds: 1989

[Dollars in millions]

Area	Total	Federal	Company
United States	$101,599	$31,366	$70,233
Northeast	27,873	6,404	21,469
New England	8,789	2,416	6,373
Maine	33	0	33
New Hampshire	(D)	(D)	95
Vermont	(D)	(D)	(D)
Massachusetts	5,825	1,691	4,134
Rhode Island	139	(D)	(D)
Connecticut	2,410	680	1,730
Middle Atlantic	19,084	3,988	15,096
New York	8,071	1,480	6,591
New Jersey	6,381	601	5,780
Pennsylvania	4,632	1,907	2,725
North Central	24,615	3,037	21,578
East North Central	19,308	1,267	18,041
Ohio	3,946	681	3,265
Indiana	1,815	(D)	(D)
Illinois	4,050	(D)	(D)
Michigan	8,468	99	8,369
Wisconsin	1,030	32	998
West North Central	5,307	1,770	3,537
Minnesota	2,066	(D)	(D)
Iowa	363	(D)	(D)
Missouri	2,380	(D)	(D)
North Dakota	(S)	0	27
South Dakota	4	0	4
Nebraska	64	(D)	(D)
Kansas	404	94	310
South	15,320	5,137	10,183
South Atlantic	8,100	2,598	5,502
Delaware	(D)	(D)	(D)
Maryland	1,088	552	536
District of Columbia	(D)	(D)	23
Virginia	1,126	687	439
West Virginia	(D)	(D)	80
North Carolina	1,305	5	1,300
South Carolina	386	(D)	(D)
Georgia	719	(D)	(D)
Florida	2,341	1,167	1,174
East South Central	1,640	653	987
Kentucky	226	0	226
Tennessee	930	(D)	(D)
Alabama	428	213	215
Mississippi	56	(D)	(D)
West South Central	5,580	1,886	3,694
Arkansas	51	(D)	(D)
Louisiana	168	(D)	(D)
Oklahoma	332	(D)	(D)
Texas	5,028	1,848	3,180

See footnotes at end of

Table B-46. Geographic distribution of funds for industrial R&D performance, by source of funds: 1989 (continued)

[Dollars in millions]

Area	Total	Federal	Company
West	$30,859	$16,089	$14,770
Mountain	4,095	1,896	2,199
Montana	(D)	(D)	5
Idaho	(D)	(D)	161
Wyoming	(D)	0	(D)
Colorado	1,162	251	911
New Mexico	1,034	(D)	(D)
Arizona	917	220	697
Utah	387	(D)	(D)
Nevada	29	(D)	(D)
Pacific	26,764	(S)	12,571
Washington	2,716	(D)	(D)
Oregon	355	30	325
California	23,675	(S)	10,818
Alaska	9	(D)	(D)
Hawaii	9	2	7
Undistributed funds	2,932	699	2,233

(D) Data have been withheld to avoid disclosing operations of individual companies.
(S) Data have been withheld due to imputation of 50 percent or more.

SOURCE: National Science Foundation, SRS

Table B-47. Distribution of Total (company, Federal, and other) R&D funds, by industry, by type of cost: 1989

[Percent]

Industry	SIC Code	R & D costs	Wages of R & D personnel	Materials and supplies	Overhead costs
Total	....	$101,599	39.9%	17.0%	43.1%
Food, kindred, and tobacco products	20,21	(D)	54.7%	9.8%	35.5%
Textiles and apparel	22,23	(D)	52.3%	20.1%	27.6%
Lumber, wood products, and furniture	24,25	170	55.9%	10.0%	34.1%
Paper and allied products	26	683	57.5%	14.1%	28.4%
Chemicals and allied products	28	11,537	46.1%	12.5%	41.5%
Industrial chemicals	281-82,286	4,056	45.2%	16.2%	38.5%
Drugs and medicines	283	(D)	44.1%	11.8%	44.1%
Other chemicals	284-85,287-89	(D)	52.1%	7.2%	40.7%
Petroleum refining and extraction	13,29	2,066	40.9%	10.5%	48.5%
Rubber products	30	(D)	45.9%	19.4%	34.6%
Stone, clay, and glass products	32	(D)	44.5%	19.6%	35.9%
Primary metals	33	768	50.0%	13.2%	36.8%
Ferrous metals and products	331-32,3398-99	(D)	51.8%	12.5%	35.7%
Nonferrous metals and products	333-36	(D)	49.0%	13.5%	37.5%
Fabricated metal products	34	788	49.4%	18.1%	32.5%
Machinery	35	(D)	40.1%	14.7%	45.2%
Office, computing, and accounting machines	357	(D)	38.4%	13.8%	47.8%
Other machinery, except electrical	351-56,358-59	2,789	47.4%	18.4%	34.3%
Electrical equipment	36	16,768	36.3%	20.5%	43.3%
Radio and TV receiving equipment	365	85	45.9%	9.4%	44.7%
Communication equipment	366	10,508	31.9%	22.0%	46.1%
Electronic components	367	4,884	43.6%	15.8%	40.6%
Other electrical equipment	361-64,369	1,291	43.6%	26.1%	30.3%
Transportation equipment	37	36,863	37.0%	21.2%	41.8%
Motor vehicles and motor vehicles equipment	371	(D)	38.1%	25.4%	36.5%
Other transportation equipment	373-75,379	(D)	50.7%	19.2%	30.1%
Aircraft and missiles	372,376	25,654	36.3%	19.5%	44.2%
Professional and scientific instruments	38	5,763	45.9%	13.8%	40.3%
Scientific and mechanical measuring instruments	381-82	1,868	52.3%	11.3%	36.3%
Optical, surgical, photographic, and other instruments	383-87	3,895	42.8%	15.0%	42.3%
Other manufacturing industries	27,31,39	(D)	60.8%	9.9%	29.3%
Nonmanufacturing industries	10-11,14-17,40-42,44-51,53-54,56,60,62-63,72-73,78,806-07,87	8,273	41.9%	11.5%	46.6%

(D) Data have been withheld to avoid disclosing operations of individual companies.

SOURCE: National Science Foundation, SRS

Table B-48. Number of full-time-equivalent (FTE) R&D scientists and engineers, by industry and size of company: 1979-90

[In thousands]

Industry and size of company	SIC code	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Total (January)................................	....	423.9	450.6	487.8	509.8	540.9	584.1	622.5	671.0	695.8	708.6	720.2	731.7
Total (Annual average).........................	....	437.3	469.2	498.8	525.4	562.5	603.3	646.8	683.4	702.2	714.4	726.0	N/A
Distribution by industry													
Food, kindred, and tobacco products (1)..............	20,21	7.4	7.2	7.4	7.4	7.7	7.4	(S)	(S)	(S)	(S)	(S)	8.3
Textiles and apparel.................................	22,23	1.8	(2)	2.0	1.9	2.2	2.3	2.8	2.6	2.4	2.4	2.4	(S)
Lumber, wood products, and furniture.................	24,25	1.8	1.7	1.6	(2)	1.8	(2)	(S)	(S)	1.3	1.3	(S)	(S)
Paper and allied products............................	26	7.1	7.4	8.0	8.4	7.6	6.6	6.6	6.4	6.0	6.1	5.7	6.7
Chemicals and allied products........................	28	50.0	51.4	54.7	61.6	67.3	69.8	71.1	75.8	75.2	75.8	77.6	78.4
Industrial chemicals...............................	281-82,286	21.4	20.9	21.6	25.9	26.6	25.6	23.5	24.9	(S)	(S)	(S)	(S)
Drugs and medicines................................	283	20.8	21.6	23.3	25.6	28.2	(2)	30.8	31.8	32.6	33.0	34.0	33.0
Other chemicals....................................	284-85,287-89	7.8	8.9	9.8	10.1	12.1	13.4	16.7	19.1	20.2	20.3	20.5	22.4
Petroleum refining and extraction....................	13,29	10.1	10.8	13.0	15.6	14.7	13.3	13.5	10.4	9.9	9.5	10.3	10.2
Rubber products......................................	30	8.1	(2)	10.3	8.1	(2)	(2)	(S)	(S)	(S)	(S)	(S)	(S)
Stone, clay, and glass products......................	32	5.2	5.4	5.6	5.1	5.5	5.6	6.6	7.5	8.6	8.6	8.5	8.7
Primary metals.......................................	33	7.9	8.1	7.9	8.4	8.3	8.4	7.1	5.7	5.5	5.6	5.7	5.7
Ferrous metals and products........................	331-32,3398-99	4.3	4.7	4.8	5.2	5.2	5.3	4.2	2.5	(S)	2.3	(S)	(S)
Nonferrous metals and products.....................	333-36	3.6	3.4	3.1	3.2	3.0	3.1	2.9	3.2	3.4	3.3	3.3	3.5
Fabricated metal products............................	34	6.8	7.8	7.8	8.2	(2)	16.6	(S)	(S)	9.9	10.5	9.7	9.4
Machinery..	35	60.2	62.1	69.2	76.0	79.6	87.0	81.7	89.7	95.8	98.4	99.8	110.9
Office, computing, and accounting machines.........	357	40.9	41.8	43.7	48.1	52.6	56.5	61.8	71.9	73.4	74.4	76.7	87.5
Other machinery, except electrical.................	351-56,358-59	19.3	20.3	25.5	27.9	27.0	30.5	19.9	17.8	22.4	24.0	23.1	23.4
Electrical equipment.................................	36	85.0	94.5	106.9	109.8	108.6	113.2	113.2	117.9	130.4	132.5	140.6	138.2
Radio and TV receiving equipment...................	365	2.1	4.0	7.9	7.8	(2)	(2)	(S)	1.8	1.2	1.3	1.3	0.7
Communication equipment............................	366	40.4	42.4	44.2	45.9	48.8	59.3	62.2	65.0	71.9	73.1	72.8	70.9
Electronic components..............................	367	14.0	18.1	22.8	24.4	25.6	(2)	29.2	(S)	43.7	44.3	(S)	48.5
Other electrical equipment.........................	361-64,369	28.5	30.0	32.0	31.7	(2)	18.4	17.9	16.5	13.6	(S)	16.7	18.1
Transportation equipment.............................	37	123.7	125.6	131.7	122.3	134.3	(2)	160.3	179.2	187.3	188.2	193.0	187.8
Motor vehicles and motor vehicles equipment........	371	35.2	38.2	35.1	30.0	29.0	28.6	28.7	33.9	46.5	47.3	45.9	(D)
Other transportation equipment.....................	373-75,379	2.0	1.5	1.4	1.2	2.2	(2)	(S)	(S)	(S)	(S)	(S)	(D)
Aircraft and missiles..............................	372,376	86.5	85.9	95.2	91.1	103.1	111.5	130.2	144.8	136.3	136.4	142.3	135.3

See footnotes at end of

Table B-48. Number of full-time-equivalent (FTE) R&D scientists and engineers, by industry and size of company: 1979-90 (continued)

[In thousands]

Industry and size of company	SIC code	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Distribution by industry													
Professional and scientific instruments	38	27.0	32.8	34.7	42.7	(2)	(2)	(S)	(S)	(S)	(S)	(S)	(S)
Scientific and mechanical measuring instruments	381-82	11.7	(2)	18.6	(2)	(2)	(2)	(S)	(S)	(S)	(S)	(S)	(S)
Optical, surgical, photographic, and other instruments	383-87	15.3	16.3	16.0	16.1	(2)	(2)	19.8	24.0	24.6	24.9	24.2	(S)
Other manufacturing industries (1)	27,31,39	4.7	4.6	4.8	5.5	5.9	(2)	(S)	(S)	6.3	6.4	5.4	5.5
Nonmanufacturing industries	10-11,14-17,40-42,44-51,53-54,56,60,62-63,72-73,78,806-07,87	17.1	19.8	22.2	27.1	31.2	49.8	66.8	75.1	96.4	101.9	(S)	(S)
Distribution by size of company [Based on number of employees]													
Less than 500		30.5	34.4	38.0	40.7	52.7	81.9	78.3	(S)	105.2	109.0	(S)	(S)
500 to 999								16.5	(S)	18.4	19.3	17.9	18.7
1,000 to 4,999		30.9	34.8	38.9	42.8	48.3	52.6	61.6	66.7	76.4	81.9	75.9	76.0
5,000 to 9,999		30.7	29.6	27.2	36.6	29.8	30.1	28.5	38.9	40.5	40.2	47.1	55.5
10,000 to 24,999		55.6	64.4	71.8	77.0	84.3	84.0	89.9	88.4	92.0	94.5	86.7	76.8
25,000 or more		276.2	287.4	311.8	312.7	325.8	335.5	347.6	365.3	363.3	365.2	387.5	396.2

N/A Not available
(1) Until 1984, tobacco products (SIC 21) was included with "other manufacturing industries."
(S) Data have been withheld due to imputation of 50 percent or more.
(2) Not separately available but included in total.
(D) Data have been witheld to avoid disclosing operations of individual companies.

SOURCE: National Science Foundation, SRS

Table B-49. Number of full-time-equivalent R&D scientists and engineers, by industry, by source of funds: January 1990

[Thousands]

Industry	SIC Code	Total	Federal	Company
Total		731.7	(S)	550.1
Food, kindred, and tobacco products	20,21	8.3	(D)	(D)
Textiles and apparel	22,23	(S)	(D)	(D)
Lumber, wood products, and furniture	24,25	(S)	(D)	(D)
Paper and allied products	26	6.7	(D)	(D)
Chemicals and allied products	28	78.4	(S)	77.9
Industrial chemicals	281-82,286	(S)	(S)	(S)
Drugs and medicines	283	33.0	(S)	(S)
Other chemicals	284-85,287-89	22.4	0.0	22.4
Petroleum refining and extraction	13,29	10.2	(1)	10.0
Rubber products	30	(S)	(D)	(D)
Stone, clay, and glass products	32	8.7	(D)	(D)
Primary metals	33	5.7	(S)	5.3
Ferrous metals and products	331-32,3398-99	(S)	(D)	(D)
Nonferrous metals and products	333-36	3.5	(D)	(D)
Fabricated metal products	34	9.4	1.3	8.1
Machinery	35	110.9	7.5	103.4
Office, computing, and accounting machines	357	87.5	(D)	(D)
Other machinery, except electrical	351-56,358-59	23.4	(D)	(D)
Electrical equipment	36	138.2	36.3	(S)
Radio and TV receiving equipment	365	0.7	0.0	(S)
Communication equipment	366	70.9	(S)	43.2
Electronic components	367	48.5	(D)	(D)
Other electrical equipment	361-64,369	18.1	(D)	(D)
Transportation equipment	37	187.8	(S)	79.5
Motor vehicles and motor vehicles equipment	371	(D)	(D)	37.0
Other transportation equipment	373-75,379	(D)	(D)	(S)
Aircraft and missiles	372,376	135.3	(S)	37.7
Professional and scientific instruments	38	(S)	(S)	(S)
Scientific and mechanical measuring instruments	381-82	(S)	(S)	(S)
Optical, surgical, photographic, and other instruments	383-87	(S)	(S)	(S)
Other manufacturing industries	27,31,39	5.5	(D)	(D)
Nonmanufacturing industries	10-11,14-17,40-42,44-51,53-54,56,60,62-63,72-73,78,806-07,87	(S)	(S)	(S)

(D) Data have been withheld to avoid disclosing operations of individual companies.
(S) Data have been withheld due to imputation of 50 percent or more.
(1) Less than 0.5 thousand.

SOURCE: National Science Foundation, SRS

Table B-50. Cost per R&D scientist or engineer, by industry and size of company: 1979-89

Industry and size of company	SIC code	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Total	....	$87,400	$94,900	$103,900	$111,600	$116,000	$124,000	$130,200	$128,500	$131,200	$137,000	$140,000
Distribution by industry												
Food, kindred, and tobacco products(1)	20,21	72,300	84,900	(D)	(D)	(D)	(D)	(D)	(D)	(S)	(D)	(D)
Textiles and apparel	22,23	53,200	57,500	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
Lumber, wood products, and furniture	24,25	79,400	89,700	(S)	(S)	(S)	115,400	116,300	(S)	(S)	(D)	(S)
Paper and allied products	26	61,400	64,300	(D)	70,800	(D)	(D)	(D)	(D)	(D)	(D)	109,700
Chemicals and allied products	28	79,600	87,400	96,600	102,500	104,800	112,500	116,300	117,100	127,600	140,400	147,900
Industrial chemicals	281-82,286	92,800	103,400	118,000	122,100	123,100	132,000	144,600	150,200	(S)	(S)	(S)
Drugs and medicines	283	71,400	79,200	(D)	(D)	103,100	(D)	(D)	113,600	(D)	141,700	(D)
Other chemicals	284-85,287-89	66,500	66,500	(D)	(D)	(D)	(D)	(D)	83,100	(D)	101,300	(D)
Petroleum refining and extraction	13,29	120,800	130,400	(D)	(D)	(D)	(D)	(D)	(D)	195,600	196,400	199,500
Rubber products	30	(D)	(D)	(D)	(D)	75,400	(D)	(D)	(D)	(D)	(D)	(D)
Stone, clay, and glass products	32	67,200	73,800	(D)	(D)	(D)	(D)	(D)	118,000	115,700	(D)	(D)
Primary metals	33	79,300	91,000	107,700	118,200	129,900	(D)	(D)	(D)	131,500	117,300	123,500
Ferrous metals and products	331-32,3398-99	83,300	93,300	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(S)	(D)
Nonferrous metals and products	333-36	74,000	87,700	(D)	(D)	(D)	112,000	136,400	138,800	(D)	(S)	(D)
Fabricated metal products	34	62,300	70,500	78,000	(S)	(S)	111,600	112,900	(S)	76,800	82,100	82,500
Machinery	35	78,900	89,900	93,900	103,800	108,400	124,500	142,500	(D)	(D)	(D)	(D)
Office, computing, and accounting machines	357	77,700	92,700	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
Other machinery, except electrical	351-56,358-59	81,400	84,700	(D)	(D)	(D)	(D)	(D)	119,200	104,700	115,500	119,900
Electrical equipment	36	87,200	91,100	95,300	100,000	114,300	121,700	124,900	120,700	120,600	118,900	120,300
Radio and TV receiving equipment	365	80,300	93,400	(D)	(D)	105,300	(D)	(D)	88,700	111,200	106,900	83,600
Communication equipment	366	87,800	92,900	105,500	123,300	135,000	143,000	147,800	141,300	140,500	141,100	146,200
Electronic components	367	72,800	75,600	66,700	69,600	(S)	100,500	114,100	(D)	97,400	(S)	(S)
Other electrical equipment	361-64,369	94,900	98,300	(D)	(D)	(D)	(D)	(D)	(D)	(S)	78,700	(S)
Transportation equipment	37				(D)	(D)	(D)	(D)	170,700	182,400	190,700	193,600
Motor vehicles and motor vehicles equipment	371	122,900	135,200	147,400	162,600	184,700	211,400	223,100	(D)	(D)	(D)	(D)
Other transportation equipment	373-75,379	90,900	111,700	(D)	(D)	114,200	(D)	(D)	(S)	(S)	(D)	(D)
Aircraft and missiles	372,376	93,300	101,600	128,400	148,800	143,600	156,000	161,700	149,800	179,400	185,900	184,900

See footnotes at end of

Table B-50. Cost per R&D scientist or engineer, by industry and size of company: 1979-89 (continued)

Distribution by industry	SIC code	1979	1980	1981	1982	1983	1984	1985				
Professional and scientific instruments	38	$83,800	$89,700	$93,400	(S)	(S)	$116,900	$122,000	(S)	(S)	(S)	(S)
Scientific and mechanical measuring instruments	381-82	(D)	(D)	(D)	(D)	$83,200	(D)	(D)	(D)	(D)	(S)	(S)
Optical, surgical, photographic, and other instruments	383-87	98,400	103,800	(D)	(D)	141,100	(D)	(D)	(D)	(D)	$150,400	(S)
Other manufacturing industries	27,31,39	61,900	77,400	(D)	(D)	98,500	(D)	(D)	(S)	(D)	(D)	(D)
Nonmanufacturing industries	10-11,14-17,40-42,44-51,53-54,56,60,62-63,72-73,78,806-07,87	83,500	86,400	77,200	$84,800	82,400	84,100	94,600	$86,800	$79,100	81,300	$81,500
Distribution by size of company [Based on number of employees]												
Less than 500		53,500	56,300	58,600	62,800	65,700	55,000	(S)	134,400	66,900	(S)	69,700
500 to 999							87,200	(S)	206,700	91,500	89,000	93,900
1,000 to 4,999		70,200	68,600	77,000	84,800	82,800	96,700	97,300	104,400	91,700	96,300	103,300
5,000 to 9,999		56,100	71,400	93,700	82,900	93,400	111,000	119,300	107,100	111,500	120,000	106,700
10,000 to 24,999		84,100	86,200	90,900	98,500	112,900	130,500	124,600	116,300	129,100	126,600	127,600
25,000 or more		96,200	105,800	117,200	128,900	134,200	143,000	155,300	156,400	163,200	171,900	175,300

NOTE: The number of full-time-equivalent R&D scientists and engineers used to estimate the cost per R&D scientist or engineer is the arithmetic mean of the numbers of R&D scientists and engineers reported for January in two consecutive years. This number is then divided into the total R&D expenditures of the earlier year, and the ratio is attributed to the earlier year.

(D) Data have been withheld to avoid disclosing operations of individual companies.
(S) Data have been withheld due to imputation of 50 percent or more.
(1) Until 1984, tobacco products, SIC 21, was included with "other manufacturing industries."
(2) Not separately available but included in total. See general notes.

SOURCE: National Science Foundation, SRS

Table B-51. Cost per R&D scientist or engineer(1), by industry, by size of company: 1989

Industry	SIC code	Total	Size of company [Based on number of employees] Less than 500 employees	500 to 999 employees	1,000 to 4,999 employees	5,000 to 9,999 employees	10,000 to 24,999 employees	25,000 or more employees
Total		$140,000	$69,700	$93,900	$103,200	$106,700	$127,600	$175,300
Food, kindred, and tobacco products	20,21	(D)	(D)	(S)	131,100	125,700	152,700	(S)
Textiles and apparel	22,23	(D)	(S)	(D)	97,600	(S)	179,600	(D)
Lumber, wood products, and furniture	24,25	(S)	(D)	(S)	129,800	(S)	215,700	(D)
Paper and allied products	26	109,700	(S)	(S)	109,700	65,500	118,400	114,100
Chemicals and allied products	28	147,900	78,100	107,800	142,400	138,200	172,000	(S)
Industrial chemicals	281-82,286	(S)	(S)	110,600	148,900	146,800	352,100	(S)
Drugs and medicines	283	(D)	(S)	183,300	162,500	(D)	158,900	(D)
Other chemicals	284-85,287-89	(D)	76,900	84,900	118,700	(D)	175,300	(D)
Petroleum refining and extraction	13,29	199,500	47,200	0	114,100	251,700	210,500	212,300
Rubber products	30	(D)	(S)	(D)	122,400	(S)	112,000	(D)
Stone, clay, and glass products	32	(D)	(S)	(D)	58,400	(S)	141,000	(D)
Primary metals	33	123,500	(D)	(D)	107,800	143,600	165,200	(S)
Ferrous metals and products	331-32,3398-99	(D)	0	0	136,500	(D)	121,000	(D)
Nonferrous metals and products	333-36	(D)	(D)	(D)	98,600	(D)	207,700	(D)
Fabricated metal products	34	82,500	(S)	(S)	92,900	(S)	133,500	0
Machinery	35	(D)	127,900	(D)	112,000	130,300	88,000	171,800
Office, computing, and accounting machines	357	(D)	(D)	(D)	93,500	133,700	71,000	(D)
Other machinery, except electrical	351-56,358-59	119,900	(D)	118,800	129,500	(S)	102,600	(D)
Electrical equipment	36	120,300	144,200	111,300	99,800	(S)	128,100	138,100
Radio and TV receiving equipment	365	83,600	(S)	(D)	(S)	(D)	0	0
Communication equipment	366	146,200	100,500	(D)	110,000	(D)	137,300	137,800
Electronic components	367	(S)	(D)	129,900	88,000	91,200	121,500	(D)
Other electrical equipment	361-64,369	(S)	(D)	101,600	114,500	(D)	138,900	(D)
Transportation equipment	37	193,600	(S)	138,400	101,000	(S)	125,800	197,400
Motor vehicles and motor vehicles equipment	371	(D)	0	(S)	105,500	(D)	89,100	(D)
Other transportation equipment	373-75,379	(D)	(D)	(D)	120,400	0	80,700	0
Aircraft and missiles	372,376	184,900	(D)	(D)	96,200	(D)	183,200	(D)

See footnotes at end of

Table B-51. Cost per R&D scientist or engineer(1), by industry, by size of company: 1989 (continued)

Industry	SIC code	Size of company [Based on number of employees]						
		Total	Less than 500 employees	500 to 999 employees	1,000 to 4,999 employees	5,000 to 9,999 employees	10,000 to 24,999 employees	25,000 or more employees
Professional and scientific instruments............	38	(S)	(D)	(S)	$88,200	(D)	$93,300	(S)
Scientific and mechanical measuring instruments..	381-82	(S)	(S)	(S)	72,500	(D)	(D)	(D)
Optical, surgical, photographic, and other instruments......................................	383-87	(S)	(D)	$99,700	103,900	$120,900	(D)	(D)
Other manufacturing industries......................	27,31,39	(D)	(S)	77,800	114,600	(D)	94,200	$0
Nonmanufacturing industries........................	10-11,14-17,40-42,44-51,53-54,56,60,62-63,72-73,78,806-07,87	$81,500	$134,100	127,300	12,300	85,200	159,100	106,300

(1) See note on table B-54.
(D) Data have been withheld to avoid disclosing operations of individual companies.
(S) Data have been withheld due to imputation of 50 percent or more.

SOURCE: National Science Foundation, SRS

Table B-52. Cost per R&D scientist or engineer(1) in companies ranked by size of R&D program: 1979-89

Companies ranked by size of R&D program (based on total R&D funds)	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
First 4......................	$121,700	$126,700	$160,200	$182,800	$185,200	$202,000	$225,800	$225,900	$222,600	$226,200	$218,100
Next 4.......................	105,700	119,200	138,900	127,600	154,000	167,000	176,200	171,400	196,900	210,700	207,000
Next 12......................	90,500	93,300	107,000	127,500	119,300	127,800	132,500	131,200	141,600	153,000	148,700
Next 20......................	87,600	97,400	101,700	104,200	117,800	121,000	144,000	125,600	146,300	154,500	154,900
Next 60......................	80,100	90,700	96,400	98,000	118,800	130,400	124,100	139,000	128,700	141,300	141,800
Next 100.....................	63,400	71,400	87,900	99,200	96,300	108,900	122,800	146,700	128,600	137,300	141,300
Next 200.....................	61,200	72,800	79,900	86,900	86,400	97,300	94,100	138,000	110,800	124,500	124,200
Average of above 400 R&D performing companies........	88,500	96,600	114,400	118,500	125,400	139,000	144,400	160,400	153,100	160,600	161,800

(1) See note on table B-54.

SOURCE: National Science Foundation, SRS

Table B-53. Domestic employment of R&D-performing companies, by industry, by size of company: 1988-89

[In thousands]
1988

Industry	SIC code	Total	Size of company [Based on number of employees] Less than 500	500 to 999	1,000 to 4,999	5,000 to 9,999	10,000 to 24,999	25,000 or more
Total	....	17,241	(S)	(S)	2,351	1,306	3,080	8,570
Food, kindred, and tobacco products	20,21	1,289	(S)	(S)	(S)	100	225	890
Textiles and apparel	22,23	(S)	(S)	(S)	(S)	62	160	(S)
Lumber, wood products, and furniture	24,25	261	(D)	(S)	86	41	56	(D)
Paper and allied products	26	563	(S)	(S)	(S)	73	197	177
Chemicals and allied products	28	1,088	(S)	28	176	68	384	333
Industrial chemicals	281-82,286	418	(S)	7	53	39	83	230
Drugs and medicines	283	338	(S)	4	41	(D)	197	(D)
Other chemicals	284-85,287-89	332	(S)	17	82	(D)	104	(D)
Petroleum refining and extraction	13,29	410	(S)	(S)	31	27	69	270
Rubber products	30	(S)	(D)	(S)	(S)	47	79	(D)
Stone, clay, and glass products	32	320	(D)	(S)	(S)	40	98	(D)
Primary metals	33	440	(S)	(S)	112	59	99	127
Ferrous metals and products	331-32,3398-99	249	(S)	(S)	48	(D)	42	(D)
Nonferrous metals and products	333-36	191	(S)	(S)	64	(D)	57	(D)
Fabricated metal products	34	591	(S)	(S)	135	62	177	0
Machinery	35	1,456	(S)	74	280	156	208	520
Office, computing, and accounting machines	357	651	28	20	81	58	65	400
Other machinery, except electrical	351-56,358-59	805	(S)	54	199	98	143	120
Electrical equipment	36	1,953	(S)	78	244	91	303	1,028
Radio and TV receiving equipment	365	27	(S)	(D)	(S)	0	(D)	0
Communication equipment	366	875	42	11	44	32	85	662
Electronic components	367	461	(S)	27	72	26	81	170
Other electrical equipment	361-64,369	590	(S)	(D)	119	33	(D)	196
Transportation equipment	37	2,622	(S)	(S)	101	113	208	2,131
Motor vehicles and motor vehicles equipment	371	1,127	(D)	(S)	48	(D)	40	921
Other transportation equipment	373-75,379	119	(D)	(S)	(S)	(D)	56	0
Aircraft and missiles	372,376	1,376	(D)	(S)	27	(D)	112	1,210

See footnotes at end of table

Table B-53. Domestic employment of R&D-performing companies, by industry, by size of company: 1988-89 (continued)

[In thousands]
1988

Industry	SIC code	Total	Less than 500	500 to 999	1,000 to 4,999	5,000 to 9,999	10,000 to 24,999	25,000 or more
			Size of company [Based on number of employees]					
Professional and scientific instruments............	38	638	(S)	29	102	36	66	309
Scientific and mechanical measuring instruments..	381-82	214	(S)	13	48	(D)	(D)	(D)
Optical, surgical, photographic, and other instruments......................................	383-87	424	(S)	16	54	(D)	(D)	(D)
Other manufacturing industries......................	27,31,39	325	(D)	(S)	(S)	46	108	(D)
Nonmanufacturing industries.........................	10-11,14-17,40-42,44-51,53-54,56,60,62-63,72-73,78,806-07,87	4,198	(S)	(S)	(S)	286	644	2,500

[In thousands]
1989

Industry	SIC code	Total	Less than 500	500 to 999	1,000 to 4,999	5,000 to 9,999	10,000 to 24,999	25,000 or more
			Size of company [Based on number of employees]					
Total..	....	16,939	(S)	(S)	2,275	1,360	2,847	8,541
Food, kindred, and tobacco products.................	20,21	1,270	(S)	(S)	(S)	103	197	821
Textiles and apparel................................	22,23	(S)	(S)	(S)	(S)	(S)	156	(S)
Lumber, wood products, and furniture................	24,25	260	(D)	(S)	82	53	46	(D)
Paper and allied products...........................	26	542	(S)	(S)	(S)	67	165	189
Chemicals and allied products.......................	28	1,084	(S)	29	179	65	352	361
Industrial chemicals..............................	281-82,286	420	(S)	8	55	47	76	229
Drugs and medicines...............................	283	333	(S)	4	43	(D)	174	(D)
Other chemicals...................................	284-85,287-89	331	(S)	17	81	(D)	102	(D)
Petroleum refining and extraction...................	13,29	406	(S)	(S)	(S)	33	68	267
Rubber products.....................................	30	446	(D)	(S)	(S)	36	91	(D)
Stone, clay, and glass products.....................	32	304	(D)	(S)	(S)	38	88	(D)
Primary metals......................................	33	447	(S)	(S)	100	64	113	126
Ferrous metals and products.......................	331-32,3398-99	248	(D)	(S)	(S)	46	42	(D)
Nonferrous metals and products....................	333-36	198	(D)	(S)	51	18	71	(D)

See footnotes at end of table

Table B-53. Domestic employment of R&D-performing companies, by industry, by size of company: 1988-89 (continued)

[In thousands]
1989

Industry	SIC code	Size of company [Based on number of employees]						
		Total	Less than 500	500 to 999	1,000 to 4,999	5,000 to 9,999	10,000 to 24,999	25,000 or more
Fabricated metal products	34	(S)	(S)	(S)	127	75	104	0
Machinery	35	1,390	(S)	69	266	172	185	481
Office, computing, and accounting machines	357	623	32	17	61	78	56	379
Other machinery, except electrical	351-56,358-59	767	(S)	52	205	94	129	102
Electrical equipment	36	1,927	(S)	75	228	118	248	1,046
Radio and TV receiving equipment	365	20	(S)	(D)	5	(D)	0	0
Communication equipment	366	861	42	11	42	31	60	675
Electronic components	367	457	(S)	(S)	77	30	67	169
Other electrical equipment	361-64,369	589	(S)	(D)	104	(D)	121	202
Transportation equipment	37	2,566	(S)	(S)	108	60	242	2,093
Motor vehicles and motor vehicles equipment	371	1,120	(D)	(D)	60	33	85	898
Other transportation equipment	373-75,379	103	(S)	4	(S)	0	65	0
Aircraft and missiles	372,376	1,343	(D)	(D)	24	27	92	1,195
Professional and scientific instruments	38	623	(S)	26	87	62	41	310
Scientific and mechanical measuring instruments	381-82	203	(D)	10	37	29	(D)	56
Optical, surgical, photographic, and other instruments	383-87	420	(D)	16	50	33	(D)	254
Other manufacturing industries	27,31,39	337	(S)	(S)	(S)	56	134	0
Nonmanufacturing industries	10-11,14-17,40-42,44-51,53-54,56,60,62-63,72-73,78,806-07,87	(S)	(S)	(S)	(S)	302	618	2,504

(S) Data have been withheld due to imputation of 50 percent or more.
(D) Data have been withheld to avoid disclosing operations of individual companies.

SOURCE: National Science Foundation, SRS

Table B-54. R&D scientists and engineers per 1,000 employees in manufacturing companies, by industry and size of company: 1979-89

Industry and size of company	SIC code	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Distribution by industry												
Total		27	27	29	33	34	40	43	45	45	47	49
Food, kindred,and tobacco products (1)	20,21	6	5	6	6	6	7	8	7	7	7	7
Textiles and apparel	22,23	3	3	3	4	4	5	5	4	4	(S)	(S)
Lumber, wood products, and furniture	24,25	6	6	(S)	(S)	(S)	6	6	5	5	5	5
Paper and allied products	26	14	14	16	14	12	13	13	11	11	11	11
Chemicals and allied products	28	42	42	44	51	54	57	57	70	68	70	72
Industrial chemicals	281-82,286	36	36	37	44	45	41	39	56	52	55	55
Drugs and medicines	283	62	60	66	74	(S)	89	81	98	98	99	101
Other chemicals	284-85,287-89	27	30	33	37	39	51	62	63	61	61	65
Petroleum refining and extraction	13,29	18	17	20	22	22	22	21	19	20	24	26
Rubber products	30	(S)	(S)	25	(S)	(S)	27	26	25	19	(S)	18
Stone, clay, and glass products	32	13	13	13	15	16	17	20	20	24	27	28
Primary metals	33	7	7	8	10	11	12	12	11	12	13	13
Ferrous metals and products	331-32,3398-99	6	6	6	8	11	11	11	7	9	9	9
Nonferrous metals and products	333-36	12	12	13	13	13	16	16	17	16	17	17
Fabricated metal products	34	12	14	15	(S)	(S)	(S)	(S)	(S)	17	17	(S)
Machinery	35	38	36	35	48	57	56	60	64	67	68	76
Office, computing, and accounting machines	357	75	72	71	80	88	90	99	107	115	116	132
Other machinery, except electrical	351-56,358-59	19	18	19	26	30	32	29	26	29	29	30
Electrical equipment	36	43	44	48	55	51	49	53	59	65	70	72
Radio and TV receiving equipment	365	29	35	51	(S)	(S)	(S)	23	55	45	48	51
Communication equipment	366	53	55	56	74	61	56	62	68	73	83	83
Electronic components	367	52	55	66	66	(S)	(S)	81	82	86	102	108
Other electrical equipment	361-64,369	32	32	34	(S)	(S)	30	30	26	28	26	30
Transportation equipment	37						(S)	71	69	68	73	74
Motor vehicles and motor vehicles equipment	371	26	30	30	31	30	27	28	38	42	41	41
Other transportation equipment	373-75,379	11	9	9	12	(S)	(S)	8	23	38	39	50
Aircraft and missiles	372,376	93	92	98	94	102	110	116	99	91	101	103

See footnotes at end of

Table B-54. R&D scientists and engineers per 1,000 employees in manufacturing companies, by industry and size of company: 1979-89 (continued)

Industry and size of company	SIC code	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Distribution by industry												
Professional and scientific instruments	38	41	39	46	(S)	(S)	(S)	(S)	(S)	71	70	72
Scientific and mechanical measuring instruments	381-82	(S)	(S)	(S)	(S)	(S)	(S)	(S)	(S)	85	94	106
Optical, surgical, photographic, and other instruments	383-87	45	48	47	(S)	(S)	(S)	70	61	63	58	56
Other manufacturing industries (1)	27,31,39	7	7	7	9	(S)	(S)	(S)	(S)	18	18	16
Distribution by size of company [Based on number of employees]												
Less than 500		24	25	28	30	34	42	50	59	59	58	60
500 to 999							21	21	23	27	26	26
1,000 to 4,999		18	19	21	22	25	24	26	32	30	31	32
5,000 to 9,999		19	19	18	23	22	19	19	28	29	29	30
10,000 to 24,999		19	20	23	26	26	29	30	33	32	34	33
25,000 or more		34	34	36	43	42	47	49	56	57	58	58

(1) Until 1984, tobacco products, SIC 21, was included with "other manufacturing industries."
(S) Data have been withheld due to imputation of 50 percent or more.

NOTE: The number of R&D scientists and engineers per 1,000 employees for 1989 is derived by dividing the arithmetic mean of scientists and engineers employed in January 1989 and January 1990 by the number of employees in all activities in March 1989. Similar procedures were used for earlier years. Nonmanufacturing industries are included in pre-1983 calculations.

SOURCE: National Science Foundation, SRS

Table B-55. R&D funds per employee, by size of company: 1979-89

Size of company [Based on number of employees]	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
	Total (company, Federal, and other) R&D funds per employee										
Total............	$2,453	$2,576	$3,010	$3,719	$4,163	$4,579	$5,148	$5,153	$5,338	$5,678	$5,998
Less than 500..........	1,254	1,418	1,634	1,732	2,186	2,767	3,028	5,414	5,553	5,318	5,495
500 to 999.............						2,158	2,238	3,229	3,121	2,900	3,174
1,000 to 4,999.........	1,321	1,326	1,596	1,790	2,042	2,480	2,725	3,261	3,395	3,232	3,448
5,000 to 9,999.........	1,102	1,332	1,668	1,883	2,194	2,505	2,851	2,849	3,210	4,009	4,024
10,000 to 24,999.......	1,549	1,748	2,045	2,469	2,966	3,385	3,500	3,334	3,668	3,725	3,664
25,000 or more.........	3,614	3,594	4,193	5,502	5,785	6,184	7,071	6,878	7,035	7,547	8,041
	Company and other (except Federal) R&D funds per employee										
Total............	$1,650	$1,764	$2,059	$2,534	$2,814	$3,095	$3,383	$3,503	$3,562	$3,804	$4,146
Less than 500..........	956	1,176	1,333	1,381	1,749	2,212	2,407	4,750	4,811	4,686	4,802
500 to 999.............						1,782	1,700	2,997	2,859	2,657	2,875
1,000 to 4,999.........	910	1,108	1,311	1,503	1,687	2,096	2,316	2,725	2,799	2,740	2,958
5,000 to 9,999.........	987	1,048	1,323	1,551	1,613	2,199	2,409	2,316	2,682	3,309	3,427
10,000 to 24,999.......	1,237	1,414	1,675	2,025	2,351	2,689	2,769	2,697	2,969	3,139	3,227
25,000 or more.........	2,271	2,273	2,641	3,436	3,637	3,792	4,208	4,077	4,010	4,346	4,863

NOTE: Averages were derived by dividing total and company R&D funds for a calendar year by employment data for March of that year.

SOURCE: National Science Foundation, SRS

Table B-56. Concentration of total employment in R&D-performing companies ranked by size of R&D program: 1984-1989

[Percent]

Companies	1984	1985	1986	1987	1988	1989
First 4 (1-4)........	8 %	8 %	7 %	7 %	7 %	7 %
Next 4 (5-8).........	3	4	4	4	3	3
Next 12 (9-20).......	6	7	5	6	6	5
Next 20 (21-40)......	9	7	6	6	5	5
Next 60 (41-100).....	10	11	9	8	9	10
Next 100 (101-200)...	13	12	7	7	8	8
Next 200 (201-400)...	15	15	10	9	9	9
All others...........	36	36	52	53	53	53

SOURCE: National Science Foundation, SRS

SECTION C. INDUSTRY-ADMINISTERED FEDERALLY FUNDED RESEARCH AND DEVELOPMENT CENTERS

Supported by the Department of Energy:

Bettis Atomic Power Laboratory
Westinghouse Electric Corporation
West Mifflin, PA

Energy Technology Engineering Center
Rockwell International Corporation
Canoga Park, CA

Hanford Engineering Development Laboratory
Westinghouse-Hanford Corporation
Richland, WA

Idaho National Engineering Laboratory
EG&G Idaho, Inc.;
Argonne National Laboratory, West;
Rockwell International Corporation;
Westinghouse Electric Corporation
Idaho Falls, IA

Knolls Atomic Power Laboratory
General Electric Company
Schenectady, NY

Oak Ridge National Laboratory
Martin Marietta Energy Systems, Inc.
Oak Ridge, TN

Sandia National Laboratories
Western Electric Company, Inc.--Sandia Corporation
Albuquerque, NM

Savannah River Laboratory
Westinghouse Electric Corporation
Aiken, SC

Supported by the National Institutes of Health, Department of Health and Human Services:

Federick Cancer Research Facility
Program Resources, Inc.
Frederick, MD

SECTION D. SURVEY DOCUMENTS

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NATIONAL SCIENCE FOUNDATION
WASHINGTON, D.C. 20550

OFFICE OF THE
DIRECTOR

Dear Respondent:

The National Science Foundation (NSF) requests your company's participation in its 1989 Survey of Industrial Research and Development by completing the enclosed questionnaire and returning it to the U.S. Bureau of the Census.

This annual survey is the only source of detailed information on U.S. industry's research and development (R&D) performance, which accounts for approximately 70 percent of total U.S. R&D expenditures. These data are used by industry officials to compare their companies' performance with industry averages, by trade association staff, and by industry consultants. Furthermore, the information is an essential element in the formulation of legislative and executive branch policy initiatives to strengthen U.S. science and technology performance.

Your company's participation in the survey is vital to the accuracy and utility of the data. Even if your records are not formatted to match exactly the survey data elements, your best estimates are requested. We urge you to obtain the assistance of your company's chief R&D official in estimating data for those items not contained in your records.

The survey is based on a performer concept, i.e., funds financing R&D performed outside your company should be excluded from the data you provide for all items except 13 and 14 at the end of the questionnaire. Please refer to the instructions for further information on definitions used in the survey and feel free to contact the U.S. Department of Commerce, Bureau of the Census, Industry Division, Washington, D.C. 20233 or phone (301) 763-5598 for assistance. Your company's responses are kept confidential by the Census Bureau staff who release survey data only in aggregated form to prevent disclosure of individual firm data.

We appreciate your past and continuing participation in this survey. The survey results are available in several NSF publications, including Research and Development in Industry. Requests for these publications and suggestions for improvements in any aspect of the survey may be addressed to Melissa Pollak or Mary Burke, Industry Studies Group, Division of Science Resources Studies, Room L-602, National Science Foundation, Washington, D.C. 20550, or phone (202) 634-4648.

Sincerely,

Erich Bloch
Director

RD-1-L1
(10-26-89)

UNITED STATES DEPARTMENT OF COMMERCE
Bureau of the Census
Washington, D.C. 20233

OFFICE OF THE DIRECTOR

FROM THE DIRECTOR
BUREAU OF THE CENSUS

The Bureau of the Census conducts the "Survey of Industrial Research and Development" under sponsorship of the National Science Foundation. These measures of research and development expenditures by industry are important in analyzing and forecasting long-term economic growth, investigating productivity determinants, formulating tax policy recommendations, and comparing individual research performance against industry averages.

We are enclosing your report form and file copy for the "Survey of Industrial Research and Development During 1989" (RD-1). To reduce response burden, we alternate between a "long" and a "short" form every other year. We are using the "long" version for 1989.

We also are enclosing an updated instruction manual to assist you in completing the report and a letter from the National Science Foundation describing the importance of the survey results. Please read the instruction manual carefully, since it provides guidelines for reporting. We recognize that you may not maintain book records for particular items. In such cases, please use carefully prepared estimates.

The law (Title 13, United States Code) authorizes this report. Items 1A and 1B and Columns 2 and 4 of Item 4C are part of the basic statistical program of the Bureau of the Census for manufacturing companies, and reporting of these items is mandatory. Response to the remainder of the inquiries is voluntary; however, we need your cooperation to make the results of the survey comprehensive and accurate. By Section 9 of the same law (Title 13), your report to the Census Bureau is confidential. Only sworn Census Bureau employees will see the information reported and will use it only for statistical purposes. The law also provides that copies retained in your files are immune from legal process.

Please return the completed form within 60 days. Please direct requests for copies of the resulting publication or any questions concerning this survey to the Special Surveys Branch of our Industry Division on (301) 763–5598. If you need additional time to complete the report or need additional forms, call (812) 288–3331. We appreciate your past cooperation in this important survey and look forward to your continued participation. Thank you.

Enclosures

FORM **RD-1 (I)**
(11-16-89)

U.S. DEPARTMENT OF COMMERCE
BUREAU OF THE CENSUS

COLLECTING AND COMPILING AGENT FOR
THE NATIONAL SCIENCE FOUNDATION
WASHINGTON, DC 20233

INSTRUCTIONS FOR SURVEY OF INDUSTRIAL RESEARCH AND DEVELOPMENT DURING 1989

Outline of instructions

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Public reporting burden for this collection of information is estimated to average 19 hours per response, including time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding the burden estimate or any other aspect of this collection of information including suggestions for reducing this burden to Herman G. Fleming, National Science Foundation, 1800 G Street, Washington, DC 20550; and to the Office of Information and Regulatory Affairs, Office of Management and Budget, Washington, DC 20503.

GENERAL

Estimates Are Acceptable — Reporting on this form may require using informed estimates in answering some of the questions. These estimates are satisfactory if they are sufficient to develop both meaningful totals and, especially, measures of change from year to year. Direct any questions regarding this form to the Bureau of the Census, ATTN: Industry Division, Washington, DC 20233, or call (301) 763–5598.

Additional Forms — Photocopies of this form are acceptable. If you require additional copies of the form, write to the Bureau of the Census, 1201 East Tenth Street, Jeffersonville, IN 47132.

Companies Reporting in Survey for the First Time — Companies which did not report in the 1988 survey are asked to provide figures for both 1988 and 1989. If the company had no expenditures for research and development, complete only Item 1. Enter "No R&D" in the space for remarks on page 3 of the form, sign and return the form.

Figures for Earlier Years are Preposted on the Form — If your company reported for 1988, entries from that form have been copied on the present form. **Please describe in the "Remarks" section (page 3 of the form) the reasons for any substantial increases or decreases in the 1989 figures entered on this form when compared to corresponding 1988 figures.** Examples of such reasons are new government contracts, acquisitions and divestitures, revised accounting method, etc. If you acquired or disposed of a unit performing an important amount of research and development during the 2-year period, please identify the unit in "Remarks," and give the total amount of research and development accounted for by such unit.

Revision of Earlier Year Figures — The 1988 figures should be revised if necessary to assure comparability with 1989 data. Please explain in "Remarks" any significant change made in the 1988 figures. If your company did not report for 1988, or if no entries have been entered in the 1988 column, please fill in the figures for both years.

Certain items on this 1989 form are asked only every other year, and consequently no prior-year figures appear in the 1988 column. The figures your company reported in 1987 for these items are preposted, however, solely to assist you in reporting for 1989, and you are not required to make revisions in the 1987 data.

Report for Your Entire Company — Research and development (R&D) activities for your entire domestic company should be reported, including all subsidiaries, divisions, etc.

Period Covered by Report — The figures reported should cover the calendar year if possible. Fiscal year data, however, are acceptable for all items except employment, provided your fiscal year ends between September and March. Please report employment figures (Item 1B and Item 3) for the specific period identified in each of the items mentioned.

Geographic Area Covered — The data relate to business firms which operate one or more establishments in one or more of the 50 States or the District of Columbia.

▶ Section I – GENERAL COMPANY DATA

▶ Item 1 – Sales and Employment for Company

▶ **Item 1A – Net Sales** — Report the net sales and receipts of this company and its subsidiaries to customers outside the company, including sales of products and services to other companies, individuals, U.S. Government agencies, foreign customers; etc. Include transfers to foreign subsidiaries. Exclude domestic intra-company transfers and sales by foreign subsidiaries. The reported figures should represent value f.o.b. plant after discounts and allowances and should exclude freight charges and excise taxes.

▶ **Item 1B – Employment** — Report the number of persons employed at the company in all activities in the 50 States or the District of Columbia during the pay periods which include March 12 of 1988 and 1989. This figure would be the same as that shown by the company in Item 1 of Treasury Form 941, if the company filed one Form 941 for the entire company.

▶ Section II – RESEARCH AND DEVELOPMENT PERFORMED WITHIN THE COMPANY IN THE UNITED STATES

▶ Item 2 – Research and Development Expenditures

Definition of Research and Development — Research and development includes basic and applied research in the sciences and in engineering, and design and development of prototype products and processes. For the purposes of this questionnaire, research and development includes activities carried on by persons trained, either formally or by experience, in the physical sciences including related engineering, and the biological sciences including medicine but excluding psychology, if the purpose of such activity is to do one or more of the following things:

1. Pursue a planned search for new knowledge, whether or not the search has reference to a specific application.

2. Apply existing knowledge to problems involved in the creation of a new product or process, including work required to evaluate possible uses.

3. Apply existing knowledge to problems involved in the improvement of a present product or process.

Research and development includes the activities described above whether assigned to separate R&D organizational units of the company or carried on by company laboratories and technical groups not part of an R&D organization. Reporting the R&D activities of such latter groups may require the use of estimates for some of the questions.

Activities to be Excluded from Research and Development — Research and development for purposes of this survey excludes capital expenditures, routine product testing, research in the social sciences or psychology, or other nontechnological activities or technical services. Please exclude geological and geophysical exploration activities; include, however, the research and development conducted in support of such activities, such as the development or improvement of techniques and processes.

More specifically, exclude from research and development such nontechnological activities as market research, including statistical surveys, market development, economic research, and legal work in connection with patent applications and litigation and the sale or licensing of patents.

Also exclude from research and development such technical services as: quality and quantity control tests and analyses; trouble-shooting in connection with breakdowns in full-scale production, including related analytical work; work required for minor adaptations of a specific product to meet the requirements of a specific customer, including installation and servicing in a customer's plant; engineering and other technical services furnished in accordance with agreements to licensees outside the company; technical plant sanitation control; aid furnished by the R&D organization to manufacturing divisions to enable them to operate in accordance with previously determined formulas, standard practice instructions, or finished product specifications; aid furnished to develop advertising programs and to promote or demonstrate new products or processes, including the cost of material furnished for trial or demonstration; assistance in preparation of speeches and publications for persons not engaged in research and development; and experimental work performed at the request of the patent division to provide information needed during the prosecution of a patent litigation.

► **Item 3 — Research and Development Scientists and Engineers** — Scientists and engineers are defined for this survey as all persons engaged in scientific or engineering work at a level which requires a knowledge of physical or life sciences or engineering or mathematics that is equivalent at least to that acquired through completion of a 4-year college course with a major in these fields, regardless of whether they actually hold a college degree in the field.

The figure on R&D scientists and engineers will be obtained primarily from two sources:

1. Records on the number of scientists and engineers assigned to research and development. This source is satisfactory as long as the scientists and engineers of the unit are assigned to research and development on a full-time basis (i.e., no more than 5 percent of their time is spent on non research and development). For example, for company laboratories performing only research and development, report the number of scientists and engineers on the rolls in January. For other units, use source 2.

2. Figures on the proportion of total work time of scientists and engineers that is devoted to research and development. For example, if the engineering department of a manufacturing plant had 60 scientists and engineers in January 1990 and one-fourth of the scientists' and engineers' time during that month was charged to R&D projects, the figure for the number of R&D scientists and engineers included for that unit would be 15.

Separate figures are requested on the number of scientists and engineers working on Federal R&D projects, and company and other R&D projects. Where R&D work for the Government and for the company is performed by the same group of scientists and engineers, distribute the total number of such scientists and engineers according to the program, Federal or company, for which the R&D work was performed.

► **Item 4 — Costs Incurred For Research and Development Performed Within the Company by Major Type and Source of Funds** — Include all costs incurred to support research and development including R&D depreciation and overhead but excluding R&D capital expenditures. If you perform research and development for others on contract, report the total charged for the work performed, including profit. Include R&D work of consultants performed at company locations. Include R&D performed within company on non-Federal contracts.

Include in R&D expenditures the full cost of all research and development performed. Do not net your R&D expenditures by the amount of royalties received from either non-company organizations or company units, or the credits received for R&D work charged or "sold" to other units of the reporting company or to outside organizations.

The relevant costs for research and development usually include but are not limited to the elements listed below:

1. Wages, salaries, and related costs; materials and supplies consumed (or purchased, if consumption figures are not available); costs of computer software used in R&D activities, utilities, such as telephone, telex, electricity, water, gas, and fuel; books and periodicals; travel costs and professional dues.

2. Property taxes and other taxes (except income taxes) incurred on account of the R&D organization or the facilities which the R&D organization uses; insurance expense; maintenance and repair, including the maintenance of buildings and grounds; depreciation on buildings, equipment, and vehicles; and rentals, if any facilities are leased.

3. Company overhead. Estimate a fair share of the cost of any functions which support R&D activities. The basis and method of estimating overhead costs will depend upon company practice. Be sure that all companies include an allowance for overhead. Items normally covered in overhead include the following: personnel; accounting; procurement and inventory, including purchasing, storage, transportation, control of materials and supplies, etc.; other services, including legal, public relations; and salaries and related costs of research executives not on the payroll of the R&D organization.

Types of Costs to be Excluded from Research and Development Performed Within the Company — Exclude R&D contracted out (See item 13) and R&D performed abroad (See item 14), such as Canada or Puerto Rico. Exclude capital expenditures, royalties paid, patent expense, income taxes, and interest; the portion of company-held R&D contracts which were subcontracted to R&D organizations outside the reporting company; and income from the sale of products manufactured in the R&D organization if these were sold to bonafide customers. Also exclude the cost of research and development performed for the company by noncompany R&D organizations of any kind. (All work that was done for your laboratories and other technical units by noncompany organizations which are **not** R&D organizations—for example, model construction by a noncompany model shop—is to be included as a **purchase** of equipment, material, or supplies for the company research organization rather than as subcontracted research and development.) Exclude fellowships, grants, and gifts to promote research and development or the study of science and engineering.

Methods of Estimating Research and Development Expenditures by Type — (Basic, Applied, and Development) — If your company does not keep records that meet or can be allocated to these specific categories, estimate by:

1. Isolating the **projects** that clearly fall in the development category. If your company fabricates products, such development activity will include the design, construction, and testing of prototypes and models. Some defense contracts typically call for several test models. If your company's research and development frequently involves the development of a "process" as in chemicals and petroleum, such development activity would include operations beyond the bench scale, primarily the design and operations of pilot plants or semiworks.

2. Isolating the **organizational units** which have R&D activities that can be readily classified, based on the function assigned to the unit. If R&D work is done in production units as well as in various laboratories, it is generally of a development type.

3. Distributing the **balance** on the basis of a review of individual projects or on the basis of other summaries of the work. Please use the definitions for basic, applied, and development, as given below.

Types of Research

► **Item 4A — Basic Research** — Include the cost of research projects which represent original investigation for the advancement of scientific knowledge and which do not have specific immediate commercial objectives (although they may be in the fields of present or potential interest to the reporting company).

► **Item 4B1 — Applied Research** — Include the cost of research projects which represent investigation directed to discovery of new scientific knowledge and which have specific commercial objectives with respect to either products or processes.

Note that the chief difference between this definition of applied research and the definition of basic research is in terms of the objectives of the reporting company.

► **Item 4B2 — Development** — Include the cost of projects which represent technical activity concerned with nonroutine problems encountered in translating research findings or other general scientific knowledge into products or processes. Exclude routine technical services to customers or other items excluded from the definition of total research and development as explained in item 2 on page 3.

Types of Activity Included in Development — Include the design and operation of pilot plants or semiworks plants as long as the principal purposes are to obtain experience and to compile engineering and other data to be used in such tasks as evaluating hypotheses, writing product formulas, establishing finished product specifications, designing special equipment and structures required by a process, and preparing operating instructions or manuals. Also include the engineering activity required to advance the design of a product or a process to the point where it meets specific functional and economic requirements and can be turned over to manufacturing units. Include the design, construction, and testing of preproduction prototypes and models and "engineering follow-through" in the early production phase; the development of designs for special manufacturing equipment and tools; the preparation of reports, drawings, formulas, specifications, standard practice instructions or operating manuals, and other media used to transmit to operating units information obtained from the above activities.

Types of Activity Excluded from Development — Exclude activities such as toolmaking and tool tryout, production of detailed construction drawings and manufacturing blueprints, and preproduction planning.

It is often difficult to decide when development ends and production begins. In general, if the primary objective is to make further improvements on the product or process, then the work comes within the definition of research and development. If, on the other hand, the product or process is substantially "set," and the primary objective is to develop market, do preproduction planning, or get the production process going smoothly, then the work is no longer research and development.

Source of Funds — Federal and Company

► **Item 4, Column 2 — Federal** — Include the cost of work done on Federal R&D contracts or subcontracts, and the R&D portions of procurement contracts and subcontracts during the year.

Do not include here R&D contracts and the R&D portions of procurement contracts that you subcontracted to other R&D organizations. To do so would cause duplication in the statistical totals derived from these forms, which collect data on work actually performed by each company. (Item 13 is the only place on the report that collects "contracted out" data.)

► **Item 4, Column 3 — Company and Other** — Include the cost of all company-sponsored research and development performed within the company as well as the research and development your company performed under contract from non-Federal sources. Exclude the research and development that was sponsored by your company but performed outside the company.

► **Item 4E — Company and Other Funds, except Federal, Budgeted for the year 1990** — Report the expected or estimated cost of company-sponsored or other non-federally sponsored research and development that will be performed within the company within the 50 States and the District of Columbia.

► **Item 5 — Costs Incurred for Federal Research and Development by Principal Agency** — Distribute the cost of Federal research and development work (item 4C, column 2) by Federal agency — If exact figures are not available by agency, please estimate or apportion according to the number of scientists and engineers working on the Federal projects and/or the costs of Federal programs.

► **Item 6 — Costs Incurred for Research and Development Performed Within the Company by Major Type of Expense** — If most research and development is performed in units where summaries are regularly prepared by element of cost, base the breakdown of research and development costs upon the records of such units. If existing records do not yield figures for this item, the item may be estimated.

► **Item 6A — Wages and Salaries** — Report the gross earnings paid in calendar year 1989 to employees engaged in research and development (follow the definition of salaries and wages that is used for calculating the withholding tax). Include salaries of officers in the research establishment(s) if a corporation; exclude payments to proprietor or partners if an unincorporated concern. (Scientists and engineers are defined in item 3.) Exclude employee fringe benefits which are to be reported in item 6C — Other Costs.

► **Item 6B — Materials and Supplies** — Report the delivered cost for all purchased materials consumed, whether received from other companies, withdrawn from inventory, or received from other establishments of this company. Include all work that was done for your laboratories and other technical units by non company organizations which are not research and development organizations (for example, model construction by a noncompany model shop). Exclude purchases from other research and development organizations.

► **Item 6C — Other Costs** — Include items related to your research and development activities and not included in items 6A and 6B. Include utilities, books and periodicals, property and other taxes, employee fringe benefits, and company overhead.

► **Item 7 — Fields of Basic Research** — Use the following definitions to help you divide your company's basic research into broad research fields.

► **Item 7A — Chemistry** — Includes inorganic, organo-metallic, organic, and physical.

► **Item 7B — Engineering (including metallurgy)** — Includes aeronautical, astronautical (including aerospace and space technology), chemical, nuclear, civil, electrical, and mechanical engineering, etc.) and metallurgy and materials.

► **Item 7C — Geological Sciences** — Includes geodesy, hydrology, geochemistry, seismology, soil sciences, etc.

► **Item 7D — Mathematics** — Includes areas such as algebra; foundations and logic; geometry; numerical analysis, etc.

► **Item 7E — Computer Sciences** — Includes activities directed toward enhancing our understanding of computer structures and computational processes to provide bases for the future capabilities for computational solutions of presently intractable problems.

► **Item 7F — Physics** — Includes acoustics; atomic and molecular; condensed matter; elementary particle; nuclear structure; optics; plasma.

► **Item 7G — Astronomy** — Includes laboratory astrophysics; optical astronomy; radio astronomy; theoretical astrophysics; Gamma-ray, neutrino astronomy.

► **Item 7H — Atmospheric Sciences** — Includes aeronomy; solar; weather modification; extraterrestrial atmospheres; meteorology.

► **Item 7I — Oceanography** — Includes biological oceanography; chemical oceanography; physical oceanography; marine geophysics.

► **Item 7J — Biological Sciences** — Includes all sciences (other than clinical medical sciences) which deal with life processes, including plant and animal sciences, biochemistry, cell biology, nutrition, microbiology, physiology, etc.

► **Item 7K — Clinical Medical Sciences** — Includes all sciences concerned with the use of scientific knowledge for the identification, treatment, and cure of disease including internal medicine, neurology, preventive medicine and public health, pathology, pharmocology, psychiatry, dentistry, veterinary medicine, etc.

► **Item 7L — Other Sciences** — To be used for multidisciplinary and interdisciplinary projects which cannot be classified within one of the above primary fields of science.

► **Item 7M — Total Basic Research Cost** — This should be the same as Item 4A, column 4.

► **Item 8 — Applied Research and Development by Product Group** — Enter both Federal and total cost of applied research and development by product group. Costs should be entered in the field which is the END PRODUCT for the firm performing the research and development. For example, research and development in very large scale integrated (VLSI) circuits would be classified by a semiconductor firm in product group 25, electronic components and accessories, if the chips are the final product sold by the firm. The same type of microelectronic research and development by a computer firm, however, would be classified in group 19, office, computing and accounting machines, if the chip were intended to be part of a computer which is the firm's end product.

Fields of applied research and development are listed below. For those companies familiar with the Standard Industrial Classification (SIC), the 1987 SIC codes are given after each title. Note that the SIC definition here applies to **each field of research and development effort,** and not necessarily to the overall code in which your company's manufacturing output is classified.

Product Group

Atomic Energy Devices — Applied Research and Development on atomic energy devices should be included with research and development as classified in the categories listed on lines 1—34. Examples of the fields of research and development activities on atomic energy devices and the product groups in which such activities should be reported are as follows:

Activity	Product Group No.
Radioactive isotopes and other radiation sources	3
Partially fabricated reactor fuel element materials and control rods	11
Nuclear reactors; reactor components and equipment; core structurals; heat exchangers and condensers; valves; complete reactor fuel elements and control rods for use in propulsion, power plants, and other; and atomic waste casks	14
Fuel handling equipment, control rod drive mechanism and components for power plants, propulsion, and other; pressurizers, components, and auxiliary equipment; and pumps	20
Atom smashers (particle acclerators)	26
Hot laboratory equipment, special instrumentation	31
Accessory instrumentation for reactor control	32

1. Food and Kindred Products (SIC 20) — Foods and beverages for human consumption and certain related products such as vegetable and animal fats and oils, and prepared feeds for animals and fowls.

2. Textile Mill Products (SIC 22) — Mill preparation of fibers and mill manufacture of yarn, thread, twine etc; manufacture of broadwoven and knit fabric, carpets and rugs; dyeing and finishing fiber, yarn, and knit apparel; coating, waterproofing, or otherwise treating fabric; the manufacture of knit apparel; other finished articles from yarn, felt goods, lace goods, nonwoven fabrics, and miscellaneous textiles.

3. Basic Industrial Inorganic and Organic Chemicals (SIC 281 and 286) — Includes alkalies and chlorine, industrial gases, inorganic pigments, and industrial inorganic chemicals not elsewhere classified (n.e.c.). Also includes industrial organic chemicals including gum and wood chemicals, cyclic crudes, and cyclic intermediates, dyes, and organic pigments, and other industrial organic chemicals n.e.c. Includes radioactive isotopes and other radiation sources.

4. Plastics Materials and Synthetic Resins, Synthetic Rubber, Synthetic and Other Manmade Fibers (SIC 282) — Includes cellulosic and noncellulosic fibers. Excludes glass which should be incuded in product group 10.

5. Drugs (SIC 283) — Medicinal chemicals, biological and botanical products, and pharmaceutical preparations.

6. Agricultural Chemicals (SIC 287) — Fertilizers, agricultural pesticides, and other agricultural chemicals.

7. All Other Chemicals (balance of SIC 28) — Explosives, soaps, glycerins, detergents and cleaning preparations, paints and varnishes, toilet preparations, and miscellaneous chemical products.

8. Petroleum Refining and Related Industries, Oil and Gas Extraction (SIC 13 and 29) — Excludes geological and geophysical exploration activities.

9. Rubber and Miscellaneous Plastics Products (SIC 30) — Fabricated rubber such as industrial and mechanical rubber goods and fabricated plastics products.

10. Stone, Clay, Glass, and Concrete Products (SIC 32) — Ceramics, glass, clay products, abrasives and asbestos products, cement, stone products, concrete products, and other nonmetallic mineral products.

11. Primary Ferrous Products (SIC 331, 332, 3399, and 3462) — Products of blast furnaces, steel works, rolling and finishing mills, iron and steel castings and forgings. Includes partially fabricated reactor fuel element materials and control rods.

12. Primary and Secondary Nonferrous Metals (balance of SIC 33 and 3463) — Primary and secondary smelting and refining of nonferrous metals, rolled, drawn, and extruded nonferrous metals products, castings and forgings.

13. Ordnance, Except Missiles (SIC 348, 3795) — Artillery, small arms, ammunition, tanks and parts, etc.

14. Fabricated Metal Products (SIC 34 except 3462, 3463, and 348, ferrous and nonferrous forgings, ordnance) — Tinwear, hand tools, nonelectric heating apparatus, fabricated structural metal products, metal stampings,fabricated wire products, etc., core structurals (barrels, cans, boxes, plates, etc.); heat exchangers, steam and barometric condensers; and valves. Nuclear reactors; reactor components and equipment.

15. Engines and Turbines (SIC 351) — Steam engines, steam, gas and hydraulic turbines, diesel and other internal combustion engines, n.e.c.

16. Farm and Garden Machinery and Equipment (SIC 352) — Farm machinery, including tractors for farm use.

17. Construction, Mining, and Materials Handling Machinery and Equipment (SIC 353) — Construction mining, and oil field machinery and equipment, elevators, conveyors, hoists, industrial trucks, tractors, trailers, and stackers.

18. Metalworking Machinery and Equipment (SIC 354) — Machine tools, dies, machine tool accessories, rolling mill machinery, power-driven hand-tools, and wire fabricating machinery and equipment.

19. Office, Computing, and Accounting Machines (SIC 357) — Electronic computing equipment; calculating and accounting machines; typewriters; other computing and office machines, (except laboratory scales and balances).

20. Other Machinery, Except Electrical (balance of SIC 35) — Special industrial machinery, except metalworking, such as food products machinery, textile and paper industries machinery, general industrial machinery and equipment, and miscellaneous machinery except electrical. Includes pumps, air and gas compressors, and industrial process furnaces and ovens. Includes atomic fuel holding equipment; control rod drive mechanism and components for use on nuclear reactors.

21. Electric Transmission and Distribution Equipment (SIC 361 and 3825) — Electric measuring instruments and test equipment, power, distribution and specialty transformers, switchgear and switchboard transformers, etc.

22. Electrical Industrial Apparatus (SIC 362) - Electric motors and generators, motor starters and controls, carbon and graphite brushes, electrodes. Nonelectronic capacitors, condensers, and rectifiers.

23. Radio and Television Receiving Equipment, Except Communication Types (SIC 365) — Radio and television sets, home recorders, prerecorded magnetic tapes, microphones, speaker systems, turntables, phonograph records, compact disc players, etc.

24. Communications Equipment (SIC 366) — Telephone and telegraph apparatus, radio and television transmitting, signaling, and detection equipment and apparatus.

25. Electronic Components and Accessories (SIC 367) — Semiconductors, computer logic modules, computer chips, solid state electronic devices, integrated circuits, electronic capacitors, transformers, connectors, cathode ray tubes, solar cells, solid state photovoltaic devices, etc.

26. Other Electrical Machinery Equipment and Supplies (balance of SIC 36) — Household appliances, electric lighting and wiring equipment, atom smashers, and miscellaneous electrical machinery, equipment and supplies.

27. Missiles (SIC 376 part) — Including frames or structures, launching and handling support equipment and work on the missile system as a whole. Exclude electronic guidance control subassemblies and radar which should be reported in product group 32.

28. Space Vehicles (SIC 376 part) — Include frames or structures, launching and handling support equipment and work on the space vehicle as a whole.

29. Aircraft and Parts (SIC 372) — Piloted and unpiloted aircraft and parts of all types, including engines and auxiliary equipment such as landing gear, de-icing equipment, and other auxiliary equipment specifically adopted for aircraft. Exclude radar and radio equipment, electronic sighting devices and aeronautical instruments which should be reported in product group 32.

30. Motor Vehicles and Equipment (SIC 371) — Motor vehicles such as ambulances, fire engines, personnel carriers, amphibian motor vehicles, truck and automobile trailers, and motor vehicle parts and accessories.

31. Other Transportation Equipment (balance of SIC 37 except 3795) — Ship building, boat building and repairing, railroad equipment, motorcycles, bicycles, and parts, etc. Exclude tanks and tank components which are in product group13.

32. Scientific and Mechanical Measuring Instruments (SIC 381, 382 part) — Engineering, laboratory, scientific, and research instruments, and associated equipment; automatic controls for regulating residential and commercial environments and appliances; industrial instruments for measurement, display, and control of process variables; nonelectric fire detecting systems; totalizing fluid meters and counting devices; instruments for measuring and testing electricity and electrical signals, and radar systems and equipment; accessory instrumentation for reactor control.

33. Optical, Surgical, Photographic, Timing and Other Instruments (SIC 382 part—387) — Optical instruments and lenses; surgical and medical instruments and apparatus; dental equipment and supplies; ophthalmic goods including contact lenses; optical fire control equipment; photographic equipment and supplies including film and motion picture appartus; watches, clocks, clockwork operated devices and parts, appliance timers, chronometers.

34. Other — Include computer software and systems engineering development (SIC 7371), paper and allied products (SIC 26), leather and leather products (SIC 31), lumber and wood products (SIC 24), etc. Please write-in category.

► **Item 9 — Cost of Research and Development Performed Within the Company, by State** — Report the cost of research and development for each state in which your company has research and development laboratories or facilities. It is not necessary to calculate separately individual assignments which may be made outside the home state of a particular research staff. As much as 10 percent of the total may, if desired, be reported in line 52 as "Not distributed by state."

► **Item 10 — Research and Development by Functional Category**

Items 10A to 10E — Energy Research and Development — Include all spending for research and development to increase energy resources or capabilities, including the development of energy equipment. Energy research and development can include costs of R&D projects (both product and process) on exploration, extraction, transportation, processing, storage, generation (including conversion), distribution, conservation, etc., of present, new, or improved forms of energy. Record energy R&D spending according to type of energy in Items 10A through 10E.

If R&D spending is for joint or multiple purposes, estimate and report the portion of cost incurred for the energy purpose. In the limited number of cases where the separation of joint (multiple) costs by type of energy cannot be estimated, include the total cost of the R&D project when the **primary** purpose of the project is energy research and development. If the project is not primarily for energy research and development then exclude all of the project cost.

► **Item 10B4 — "Coal"** — "Synthetic fuels" includes programs designed to convert coal to gaseous and liquid products. "Mining" is composed of programs for developing equipment and techniques to improve the productivity and recovery rates of coal mining.

► **Item 10C3 — "Conservation and Utilization"** — Includes R&D activities undertaken to reduce consumption either at the point of energy use or in the transmission, transportation, storage, and conversion of energy. Examples of such are research and development undertaken primarily to reduce fuel consumption in manufacturing, to improve the efficiency of transportation of energy products, or to produce an end product which is more efficient in energy consumption.

Item 10D — "All Other Energy" — Includes areas such as wind, waste, hydroelectric, etc. Also include in this category the development of energy equipment which cannot be readily classified in Items 10A to 10C.

Items 10F to 10J — Pollution Abatement Research and Development — Includes R&D spending for the purpose of reducing or eliminating the emission of pollutants. "Pollution" refers to the emission of pollutants to the outside of a firm's (or household's) property or activities; "abatement" includes prevention, treatment or recycling. Exclude spending to contribute to environmental aesthetics, to increase equipment durability in corrosive environments, to conserve energy (include as energy R&D in Item 10C) and natural resources, or to increase employee comfort, safety, and health.

If the only purpose of the R&D spending is pollution abatement, include the total expenditures on the R&D project. (Examples are spending on projects to improve or design alternatives to electrostatic precipitators, wet scrubber systems, waste treatment systems, effluent monitoring devices, etc.) If pollution abatement is only one of several purposes, estimate and report only the portion of R&D costs incurred due to the pollution abatement purpose. (Examples of multipurpose projects are those designed to improve production processes or products while simultaneously reducing the emission of pollutants, or pollution abatement projects combined with other purposes such as energy conservation or employee safety and health.)

In the limited number of cases where the separation of joint costs is not feasible, include the total cost of the R&D project when the purpose is primarily (more than 50 percent) for pollution abatement.

If the project is not primarily for pollution abatement, then exclude all of the project cost. Also exclude project costs if expected pollution abatement benefits are incidental. (Incidental benefits are those obtained at no extra cost.)

► **Item 10F — Air** — 1. Automotive emissions includes all R&D efforts undertaken to reduce exhaust emissions from automobiles. 2. Electric power plant emissions includes efforts directed toward reducing airborne emissions from electric power plants. 3. "All other" includes efforts directed at removing sulfur oxide, nitrogen oxides and particulates, and other fossil-fuel pollutants from the atmosphere.

► **Item 10G — Water** — Includes R&D spending on water recirculation or thermal pollution abatement, etc.

► **Item 10H — Solid Waste** — Includes R&D spending on waste compacting devices, etc.

► **Item 10I — Other** — Includes R&D spending on pollution abatement from noise and radiation, etc.

► **Item 11 — Product Versus Process Applied Research and Development** — Data not collected for 1989.

► **Item 12 — Long Versus Short Term Research and Development Costs** — Data not collected for 1989.

► **Section III — RESEARCH AND DEVELOPMENT PERFORMED OUTSIDE THE COMPANY — (R&D not included in Item 4).**

► **Item 13 — Total Company Funds Spent for Research and Development Activities Performed Outside the Company Within the United States** — Includes payments for research and development activities in the form of contracts, grants, fellowships, etc., made to other industrial firms, commercial laboratories, consultants, educational institutions, hospitals, research institutions, etc. (Please exclude subcontracting of R&D contracts received from the Federal Government or other companies.)

► **Item 14 — Total Company Funds Spent for Research and Development Activities Performed by Foreign Subsidiaries Outside the United States** — Report the amount of research and development financed by the U.S. parent or its foreign subsidiaries and performed by company R&D laboratories, branch plants, divisions, etc., or by other organizations, located outside the United States. Include R&D funds spent in Canada and Puerto Rico.This item excludes R&D activities performed by foreign subsidiaries which were financed by foreign governments or other outside organizations.

NOTE — Foreign subsidiaries are those outside the 50 States or the District of Columbia.

► **Item 15 — Status of This Company on December 31, 1989** — In the "Remarks" section, specify change or correction, e.g., "wholly-owned subsidiary of ABC Company", "merger with XYZ Company", "acquired by 123 Corporation." Provide date of organizational change.

☆ U.S. GOVERNMENT PRINTING OFFICE. 1989 — 748-034 00289

DUE DATE: 60 DAYS AFTER RECEIPT OF FORM

OMB No. 3145-0027: Approval Expires 06/30/90

NOTICE — Your report to the Census Bureau is confidential by law (title 13, U.S. Code). It may be seen only by sworn Census employees and may be used only for statistical purposes. The law also provides that copies retained in your files are immune from legal process.

Bureau of the Census
1201 East Tenth Street
Jeffersonville, IN 47132

Name of person who supplied 1988 data

Data supplied in items 1A and 1B and in item 4C, columns 2 and 4, for 1989 on this form, will satisfy the mandatory reporting requirement of Census Form MA-121 (title 13, U.S. Code). Your cooperation on the other items is essential to make the results of this survey comprehensive, accurate, and timely.

CENSUS USE ONLY

SURVEY CODE
4001

INDUSTRY CODE

WEIGHT

STATE

ADDRESS

SIC CODE

FORM **RD-1**
(7-14-89)

SURVEY OF INDUSTRIAL RESEARCH AND DEVELOPMENT DURING 1989

U.S. DEPARTMENT OF COMMERCE
BUREAU OF THE CENSUS
COLLECTING AND COMPILING AGENT FOR
THE NATIONAL SCIENCE FOUNDATION

In correspondence pertaining to this report refer to this CENSUS FILE NUMBER (11 digits)

PLEASE RETURN THIS COPY

(Please correct any error in name, address, and ZIP Code.)

GENERAL INSTRUCTIONS

- Please complete this form and return within 60 days in the envelope provided. Retain the file copy for your records. THIS REPORT SHOULD COVER YOUR ENTIRE COMPANY, INCLUDING ALL SUBSIDIARIES, UNLESS OTHERWISE DESIGNATED.
- Enter 0 (zero) where appropriate rather than leaving a blank space.
- Reasonably accurate estimates are acceptable.
- Figures for 1987 are those reported by your company in that year. They are included solely to assist you in reporting 1989 data.
- Figures for 1988 are those reported by your company last year. THE 1988 FIGURES SHOULD BE REVISED, IF NECESSARY, TO BE COMPARABLE WITH 1989 DATA.
- Explain in "Remarks" on the back page any substantial increases or decreases in 1989 figures over 1988 (e.g., new government contracts, acquisitions, mergers, divestitures, etc.)

PLEASE READ ENCLOSED INSTRUCTIONS BEFORE COMPLETING THIS FORM

[illegible] GENERAL COMPANY DATA

Item 1 — DOMESTIC SALES, RECEIPTS, AND EMPLOYMENT FOR COMPANY	1988	1989
A. Domestic net sales and receipts of this company *(Thousands of dollars)*	101	102
B. Total domestic company employment in all activities during the pay period which includes the 12th of March 1988 and 1989	103	104

[illegible] PERFORMED WITHIN THE COMPANY IN THE UNITED STATES

[illegible] performed by others. Report such R&D [illegible]

Item 2 — RESEARCH AND DEVELOPMENT EXPENDITURES

Are research and development expenditures for entire domestic company, including subsidiaries, reported on this form? ☐ YES ☐ NO — *Please explain in remarks or on transmittal letter*

Item 3 — NUMBER OF SCIENTISTS AND ENGINEERS INVOLVED IN RESEARCH AND DEVELOPMENT ACTIVITIES Apportion on a full-time equivalent basis. *(See instruction manual)*	January 1989	January 1990
A. Federal research and development		111
B. Company and other research and development		112
C. TOTAL *(Sum of A and B)* →	113	114

Item 4 — COSTS INCURRED FOR RESEARCH AND DEVELOPMENT PERFORMED WITHIN THE COMPANY BY MAJOR TYPE AND SOURCE OF FUNDS

Include R&D depreciation and overhead; exclude R&D capital expenditures. *(See instruction manual)*

		Thousands of dollars			
		1988	1989		
		TOTAL research and development (1)	Federal funds (2)	Company and other funds, except Federal (3)	TOTAL *(Sum of columns 2 and 3)* (4)
A. Basic research *If "None," please mark (X)* ☐		201	202	203	204
B. Applied research and development	1. Applied research	211	212	213	214
	2. Development	221	222	223	224
	3. TOTAL *(Sum of lines 1 and 2)*	231	232	233	234
C. TOTALS *(Sum of A and B3)* →			242	243	244
D. 1988 TOTALS →			252	253	254
E. Company and other funds, except Federal, budgeted for the year 1990 →				263	

Item 5 — COSTS INCURRED FOR FEDERAL RESEARCH AND DEVELOPMENT BY PRINCIPAL AGENCY

(Breakdown of item 4C, column 2)

	Thousands of dollars		
	1987	1988	1989
1. Department of Defense		NOT ASKED	301
2. National Aeronautics and Space Administration			302
3. Department of Energy			303
4. All other Federal Agencies			304
5. TOTAL COST *(Sum of 1, 2, 3, and 4)* →			305

Item 6 — COSTS INCURRED FOR RESEARCH AND DEVELOPMENT PERFORMED WITHIN THIS COMPANY BY MAJOR TYPE OF EXPENSE

	Thousands of dollars		
	1987	1988	1989
A. Wages and salaries of research and development personnel *(Include scientists and engineers, technicians, secretaries, and other personnel)*		NOT ASKED	311
B. Costs of materials and supplies consumed *(Do not include in this item components, models, and other materials supplied by other research organizations)*			312
C. Other costs *(Include service and supporting costs, R&D depreciation, and share of overhead)*			313
D. TOTAL COSTS *(Sum of A through C) (Same as item 4C, column 4)* →			314

(RD-1-1)

PLEASE CONTINUE ON NEXT PAGE

FORM RD-1 (Items 7, 8, 9)
[illegible]

SURVEY OF INDUSTRIAL RESEARCH AND DEVELOPMENT DURING 1989

U.S. DEPARTMENT OF COMMERCE
BUREAU OF THE CENSUS
COLLECTING AND COMPILING AGENT FOR
THE NATIONAL SCIENCE FOUNDATION

Refer to this CENSUS FILE NUMBER in any correspondence pertaining to this report

SECTION II — RESEARCH AND DEVELOPMENT PERFORMED WITHIN THE COMPANY IN THE UNITED STATES — Continued

(Exclude R&D financed by the company but performed by others. Report such R&D in section III.)

Item 7 — FIELDS OF BASIC RESEARCH

Allocate the total reported in Item 4A for basic research into the following fields of science and engineering.

	Thousands of dollars		
	1987	1988	1989
A. Chemistry		↑	401
B. Engineering (including metallurgy)			402
C. Geological sciences			407
D. Mathematics			408
E. Computer sciences		NOT ASKED	409
F. Physics			410
G. Astronomy			411
H. Atmospheric sciences			412
I. Oceanography			413
J. Biological sciences			414
K. Clinical medical sciences			415
L. Other — *Specify*			417
M. TOTAL BASIC RESEARCH COST *(Same as item 4A, column 4)* →		↓	418

Item 8 — APPLIED RESEARCH AND DEVELOPMENT BY PRODUCT GROUP

Allocate the total reported in 4B, line 3, applied research and development, into the following product groups which represent the END PRODUCT for the firm.

(See instructions on how to classify the applied research and development)

	Thousands of dollars				
	1987		1988	1989	
	Federal	Total		Federal	Total
1. Food and kindred products			↑	501	502
2. Textile mill products				503	504
3. Industrial inorganic and organic chemicals				505	506
4. Plastics materials and synthetic resins, rubber, and fiber				507	508
5. Drugs				509	510
6. Agricultural chemicals				511	512
7. All other chemicals				513	514
8. Petroleum refining				515	516
9. Rubber and miscellaneous plastics products				517	518
10. Stone, clay, glass, and concrete products				519	520
11. Primary ferrous products				521	522
12. Primary and secondary nonferrous metals				523	524
13. Ordnance, except missiles				525	526
14. Fabricated metal products				527	528
15. Engines and turbines				529	530
16. Farm machinery and equipment			NOT ASKED	531	532
17. Construction, mining, and materials handling machinery				533	534
18. Metalworking machinery and equipment				535	536
19. Office, computing and accounting machines				537	538
20. Other machinery, except electrical				539	540
21. Electric transmission and distribution equipment				541	542
22. Electrical industrial apparatus				543	544
23. Radio and television receiving sets, except communication types				545	546
24. Communications equipment				547	548
25. Electronic components and accessories				549	550
26. Other electrical machinery equipment and supplies				553	554
27. Missiles				555	556
28. Space vehicles				557	558
29. Aircraft and parts				559	560
30. Motor vehicles and equipment				561	562
31. Other transportation equipment				563	564
32. Scientific and mechanical measuring instruments				565	566
33. Optical, surgical, photographic, and other instruments				567	568
34. Other — *Specify*				571	572
35. TOTAL APPLIED RESEARCH AND DEVELOPMENT COSTS *(Same as item 4B3, columns 2 and 4)* →			↓	573	574

Item 9 — COST OF RESEARCH AND DEVELOPMENT PERFORMED WITHIN THE COMPANY, BY STATE

Allocate the totals reported in Item 4C, columns 2 and 4, by the States in which your various research and development laboratories or facilities are located. Estimate the costs associated with each State. If necessary, you may report up to 10 percent of your total as "Not distributed by State."

State	Thousands of dollars					State	Thousands of dollars				
	1987		1988	1989			1987		1988	1989	
	Federal	Total		Federal	Total		Federal	Total		Federal	Total
1. AL			↑	601	602	27. MT			↑	653	654
2. AK				603	604	28. NE				655	656
3. AZ				605	606	29. NV				657	658
4. AR				607	608	30. NH				659	660
5. CA				609	610	31. NJ				661	662
6. CO				611	612	32. NM				663	664
7. CT				613	614	33. NY				665	666
8. DE				615	616	34. NC				667	668
9. DC				617	618	35. ND				669	670
10. FL			NOT ASKED	619	620	36. OH				671	672
11. GA				621	622	37. OK			NOT ASKED	673	674
12. HI				623	624	38. OR				675	676
13. ID				625	626	39. PA				677	678
14. IL				627	628	40. RI				679	680
15. IN				629	630	41. SC				681	682
16. IA				631	632	42. SD				683	684
17. KS				633	634	43. TN				685	686
18. KY				635	636	44. TX				687	688
19. LA				637	638	45. UT				689	690
20. ME				639	640	46. VT				691	692
21. MD				641	642	47. VA				693	694
22. MA				643	644	48. WA				695	696
23. MI				645	646	49. WV				697	698
24. MN				647	648	50. WI				699	700
25. MS				649	650	51. WY				701	702
26. MO			↓	651	652	52. *				703	704
53. TOTAL COSTS *(Same as item 4C, columns 2 and 4)* →									↓	705	706

(RD-1-2)

*Not distributed by State

PLEASE CONTINUE ON NEXT PAGE

FORM **RD-1 (Items 10 through 16)**
(7-14-89)

SURVEY OF INDUSTRIAL RESEARCH AND DEVELOPMENT DURING 1989

U.S. DEPARTMENT OF COMMERCE
BUREAU OF THE CENSUS
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SECTION II – RESEARCH AND DEVELOPMENT PERFORMED WITHIN THE COMPANY IN THE UNITED STATES – Continued

(Exclude R&D financed by the company but performed by others – Report such R&D in section III.)

Item 10 – RESEARCH AND DEVELOPMENT BY FUNCTIONAL CATEGORY
Of the total reported in Item 4C, columns 2 and 4, report the following functional categories.

ENERGY RESEARCH AND DEVELOPMENT Include the project cost or portion of project cost incurred for the purpose of increasing energy resources or capabilities. Include cost by type of energy.	*Thousands of dollars*					
	1988		**1989**		**1990**	
	Federal funds	Total funds	Federal funds	Total funds	Projected Federal funds	Projected total funds
A. Total nuclear	801	802	803	804	805	806
1. Fission	NOT ASKED	NOT ASKED	807	808	809	810
2. Fusion			811	812	813	814
B. Total fossil fuels	815	816	817	818	819	820
1. Oil	NOT ASKED	NOT ASKED	821	822	823	824
2. Gas			825	826	827	828
3. Shale			829	830	831	832
4. Coal			833	834	835	836
a. Synthetic fuels			837	838	839	840
b. Mining			841	842	843	844
c. All other			845	846	847	848
5. Other fossil fuels			849	850	851	852
C. Total geothermal, solar, conservation and utilization	853	854	855	856	857	858
1. Geothermal	NOT ASKED	NOT ASKED	859	860	861	862
2. Solar			863	864	865	866
3. Conservation and utilization			867	868	869	870
D. All other energy	871	872	873	874	875	876
E. Total of A through D →	877	878	879	880	881	882

POLLUTION ABATEMENT RESEARCH AND DEVELOPMENT Include the project cost or portion of the project cost incurred for the purpose of designing pollution abatement products or product characteristics or of designing pollution abatement features into processes. Include cost by form of pollution to be abated.	*Thousands of dollars*					
	1988		**1989**		**1990**	
	Federal funds	Total funds	Federal funds	Total funds	Projected Federal funds	Projected total funds
F. Air	NOT ASKED	NOT ASKED	901	902	903	904
1. Automotive emissions			905	906	907	908
2. Electric power plant emissions			909	910	911	912
3. All other			913	914	915	916
G. Water			917	918	919	920
H. Solid waste			921	922	923	924
I. Other			925	926	927	928
J. Total of F through I →	929	930	931	932	933	934

Item 11 – PRODUCT VERSUS PROCESS APPLIED RESEARCH AND DEVELOPMENT

NO LONGER COLLECTED

Item 12 – LONG VERSUS SHORT TERM RESEARCH AND DEVELOPMENT COSTS

NO LONGER COLLECTED

SECTION III – RESEARCH AND DEVELOPMENT PERFORMED OUTSIDE THE DOMESTIC COMPANY WITH COMPANY FUNDS

[illegible]

Item 13 – TOTAL COMPANY FUNDS FOR RESEARCH AND DEVELOPMENT ACTIVITIES FINANCED BY THE COMPANY BUT PERFORMED BY OTHERS OUTSIDE THE COMPANY WITHIN THE UNITED STATES
Include other industrial firms, colleges and universities, nonprofit organizations, etc. Exclude subcontracting of Federal government and other contracts. *(See instruction manual)*

Thousands of dollars		
1987	**1988**	**1989**
	NOT ASKED	971

Item 14 – TOTAL COMPANY FUNDS SPENT FOR RESEARCH AND DEVELOPMENT ACTIVITIES PERFORMED BY FOREIGN SUBSIDIARIES OR BY OTHER ORGANIZATIONS OUTSIDE THE UNITED STATES

Thousands of dollars	
1988	**1989**
972	973

Item 15 – STATUS OF THIS COMPANY ON DECEMBER 31, 1989

A. Was the company listed in the address label owned or controlled by another company on December 31, 1989? ☐ Yes – *Complete item 15B* ☐ No

B. New owner information

Name 985		Date acquired 986
Address *(Number and street)* 987		
City 988	State 989	ZIP code 990

REMARKS – *If more space is required, continue on reverse.*
991

Item 16 – CERTIFICATION – This report is substantially accurate and has been prepared in accordance with instructions.

Key	Name of person to contact regarding this report – *Print or type*			Mo.	Day	Year
992						
	Telephone			Signature of authorized official		
	Area code	Number	Extension			
993						

(RD-1-3)

DUE DATE: 15 DAYS AFTER RECEIPT OF FORM OMB No. 3145-0027: Approval Expires 09/30/9

FORM **MA-121**
(7-13-89)

U.S. DEPARTMENT OF COMMERCE
BUREAU OF THE CENSUS

COMPANY SUMMARY OF RESEARCH AND DEVELOPMENT

1989

NOTICE — Response to this inquiry is required by law (title 13, U.S. Code, sections 131, 182, 224, and 225). By section 9 of the same law, your report to the Census Bureau is confidential. It may be seen only by sworn Census employees and may be used only for statistical purposes. The law also provides that copies retained in your files are immune from legal process.

(Please correct any error in name, address, and ZIP Code)

RETURN TO

Bureau of the Census
1201 East Tenth Street
Jeffersonville, IN 47132

Please complete and return this form in the return envelope not later than 15 days after you receive it. Companies with no research and development expenditures should so state in the "Remarks" section, fill in items 1a and 1b, sign, and return the form.

PLEASE RETURN THIS COPY

PLEASE READ INSTRUCTIONS ON REVERSE SIDE BEFORE COMPLETING YOUR REPORT

Item 1 — SALES AND EMPLOYMENT FOR COMPANY	**1989** *(Thousands of doll*
a. Domestic net sales and receipts of this company	102
	Number
b. Total domestic company employment in all activities during the pay period which includes the 12th of March 1989	104

	1989 *(Thousands of dollars)*		
	Federal funds (2)	Company and other funds, except Federal (3)	**TOTAL** *(Sum of columns 2 and 3)* (4)
Item 2 — COST OR RECEIPTS FOR RESEARCH AND DEVELOPMENT PERFORMED WITHIN THE COMPANY DURING 1989	242	243	244

Remarks
991

Item 3 — STATUS OF THIS COMPANY ON DECEMBER 31, 1989

a. Was the company listed in Item 1 owned or controlled by another company on December 31, 1989? ☐ Yes — *Complete item 3B* ☐ No

b. New owner information

Name 985		**Date acquired** 986
Address *(Number and street)* 987		
City 988	**State** 989	**ZIP Code** 990

Please continue on reverse ⟶

GENERAL INSTRUCTIONS

A report should be filed by each company receiving a copy of this form. If your company does not conduct research and development, so state in remarks, fill in items 1a and 1b, sign, and return the form. If you have questions regarding reporting problems on this form, please write to the Bureau of the Census, Industry Division, Washington, DC 20233.

Report for your entire company — Research and development activities for your entire domestic company should be reported.

Period covered by report — The cost figure reported should cover the calendar year if at all possible. However, fiscal year data are acceptable, provided your fiscal year ends between September and March.

DEFINITION OF RESEARCH AND DEVELOPMENT

Research-development includes basic and applied research in the sciences (including medicine) and in engineering, and design and development of prototypes, products, and processes. It does not include quality control, routine product testing, market research, sales promotion, sales service, research in the social sciences or psychology, or other nontechnological activities or technical services.

SPECIFIC INSTRUCTIONS BY ITEM

Item 1 — Sales and Employment for Company. In item 1a, report the net billings of this company and its subsidiaries to customers outside the company. (Exclude domestic intra-company transfers and sales by foreign subsidiaries. Include the transfers to such foreign subsidiaries, however.) In item 1b, report the number of persons employed by the company in all activities in the 50 States and the District of Columbia during the pay period which includes the 12th of March 1989.

This figure would be the same as that shown by the company in item 1 of Treasury Form 941, if the company filed one form 941 for the entire company.

Item 2 — Show all costs incurred within the company for wages and salaries, direct material costs, services and supporting costs, and an appropriate share of company overhead to conduct research and development activities.

Under Federal funds, include research and development in procurement as well as research and development contracts and research and development subcontracts. Exclude research and development subcontracted to others.

Remarks (Continued)
991

Name of person to contact regarding this report 992	**Address** *(Number and street, city, State, ZIP Code)*	**Telephone** *(Area code, number, extension)* 993

CERTIFICATION — This report is substantially accurate and has been prepared in accordance with instructions.

Name of company	**Address** *(Number and street, city, State, ZIP Code)*	
Signature of authorized official	**Title**	**Date**

FORM MA-121 (7-13-89)